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THE MOBILIZATION OF SCIENCE IN NATIONAL DEFENSE[1]

By Dr. FRANK B. JEWETT

CHAIRMAN OF THE BOARD, BELL TELEPHONE LABORATORIES

There is perhaps no audience before which the role of science and engineering in modern warfare can more appropriately be discussed than one composed of members of the Institute of Radio Engineers. You are primarily communication engineers and of all the branches of applied science, that which has to do with the rapid transmission of intelligence is perhaps most vital to the successful use of the modern fighting instrumentalities. Rapid movement of troops and supplies over far-flung lines of action on sea and land and in the air are possible only on the basis of very effective systems of radio communication. In fact, more and more are means of communication assuming the function of a unifying influence which pervades the other arms of the military organization. They coordinate the movement of naval and aerial fleets. They enable infantry, tank columns and formations of planes to operate as a single effective unit. They shrink, as nothing else can, a 2,000-mile battleline to the compass of a single sector.

The telephone and telegraph and particularly the radio telephone and telegraph are, in effect, the keystone of the whole military arch. You members of the Institute of Radio Engineers are, therefore, exponents of a very vital department of technology, and I am particularly grateful to you for affording me

[1] Winter convention, Institute of Radio Engineers, Hotel Commodore, New York, N. Y., January 12.

the opportunity to speak here at this time to discuss the mobilization of science in the war program.

Further, it is not merely in the fields we ordinarily think of as communication that men who have devoted their lives to the problems of radio development are in position to render great service.

One of the striking things connected with the development of new military tools, both offensive and defensive, is the astounding extent to which the fundamental phenomena on which electrical communication is based are employed. In some cases it is application of established techniques in entirely new fields. More frequently it is the pushing of our frontiers of knowledge farther out, and then applying that knowledge to the problems of war in three-dimensional space. Basically, every military problem hinges on the rapid and exact location of an enemy objective and in transmitting and utilizing the knowledge acquired. This may be for the guidance of a commanding officer; the accurate pointing, fuse setting and firing of a gun; the release of an aerial bomb, or any one of a hundred similar things. Every single physical phenomenon which can be employed must be examined. Because modern science has changed the conditions of warfare from a slow-moving affair in localized areas to one of great rapidity over incredible distances of land, sea and air, it is imperative that those phenomena which have given us radio be developed and utilized to the full.

While the initial problem is one of intense research and development, each step forward involves great numbers of skilled technicians in design, manufacture, maintenance and operation of new implements. It seems clear that the demand for men trained in our art is bound to be enormous, not alone in the laboratory but in the services of supply and in the combat forces as well.

For fifteen years following the first World War there were frequent articles on the probable role of science in future warfare. While this was quite natural in view of the part played by the airplane, the tank and lethal gas in the titanic struggle of 1914–18, the articles in the main evoked interest rather than concerted action directed toward full employment of science in preparation for more wide-spread and more deadly warfare.

Despite the fact that the decade and a half following the war was a period of the most productive activity in fundamental science research and of intense effort to apply old and new knowledge promptly in industry, this *laissez-faire* attitude in the military sector was largely a reflection of men's attitude generally toward war. The weariness of the struggle and the distaste for carnage and destruction, coupled with a naive faith that men had learned finally the lesson of war's futility, gave rise to the era of small appropriations to the military, to disarmament conferences and to the League of Nations and similar efforts to organize the world for a settlement of international controversies by reasonable methods rather than by recourse to mass murder.

In the United States particularly, the decade of the 1920's saw this carried to the extreme. Warships were taken to sea and sunk or were laid up and the Army was reduced to the status of a moderate sized police force—a force so small and scattered that no really effective training or development of radically new implements could be had. Appropriations were cut to the irreducible minimum of maintaining a national agency which the country would have liked to abolish entirely had it quite dared. In this atmosphere and under these handicaps it is to the credit of the Army and Navy that they did as well as they did. There was little money to spend on development and less still for research to produce entirely new instruments of war.

When the storm clouds of another world war began to form in the middle 1930's, the volume of articles on the place and importance of modern science in warfare increased enormously in both the scientific and lay press. So, too, did discussion of the need for insuring that scientific and technical men should be utilized in the fields of their competence and not inducted indiscriminately into the combat services where men of less specialized training could serve equally well.

So far as lay discussion was concerned, it was largely emotional, frequently ill-informed and sometimes fantastic. Naturally, discussion among technical people was more realistic, but on the whole was mainly related to applying newly acquired knowledge and techniques to the improvement of existing military implements. The idea of organizing scientific research on a huge industrial scale, where the ultimate end of "all out war" was the industry to be served, was slow to emerge.

Probably the most difficult hurdle every industry has had to get over in the effective introduction of scientific research as a powerful tool in its operation, has been to realize that the most profitable research is that which is carried on with the least restraint imposed by current practice. Practice can be adapted to radically new ideas, but radical ideas rarely, if ever, evolve from mere improvements in current practice.

Research in military matters is no exception. War being a very ancient art, military men are on the whole extremely conservative as to new tools. Like doctors, long experience has made them cautious and with possibly a more than ordinary tendency to impose on a research project requirements of current

practice which, in fact, hamper rather than help. Against this tendency is the fact that they are quick to adopt the radically new once its utility is demonstrated. War more than any other of man's activities puts a high premium on being in the lead.

As soon as war in Europe on a vast scale was seen to be imminent, the nations there commenced frantically to mobilize and organize their scientific and technical men and resources, and to establish effective liaison between them and the combat services. For more than a year after this movement was in full swing across the Atlantic, our aloofness from the struggle and our ardent desire to keep from being sucked into the tragic maelstrom operated to prevent any effective steps in the direction of mobilizing our vast scientific resources for total war. The military services endeavored to strengthen their scientific branches and here and there enlisted the aid of civilian science. They were hampered by inadequate funds, by the pattern of years of a starved organization imposed by an anti-war philosophy, and by the fact that civilian sciences, both fundamental and applied, were built up on a basis of operation in a slow-moving peace economy. The latter had no machinery for marshalling its forces for war and, in the main, it knew little of war's requirements and frequently preferred to follow the courses it understood and liked.

But about two years ago, it became apparent to a few individuals that the *laissez-faire* approach to the mobilization of science ought to be abandoned in favor of a more direct and forceful organizational approach. At that time there existed certain technical groups and associations which, on the one hand, called for strengthening, and on the other were of suggestive value in the search for a suitable organizational set-up. I have already remarked upon the scattered technical groups and laboratories within the Army and Navy which over the years had been doing commendable work, but had been given insufficient funds and encouragement. It was, of course, obvious that as the tension of the emergency increased, the responsibilities placed upon these technical groups would mount with a resultant need to augment their personnel, but it was equally apparent that they could not be expected to carry the full load of scientific development and adaptation.

Civilian participation in one way or another in the solution of military problems has come to be taken for granted. It was first given official recognition in the United States when the National Academy of Sciences was incorporated in 1863 by an Act of Congress. The charter of the academy requires that whenever called upon by any department of the Government, it shall investigate, examine, experiment and report upon any subject of science or art, the actual expenses of such investigations, experiments and reports to be paid from appropriations which may be made for the purpose, but the academy shall receive no compensation whatever for any services to the Government. The academy is, therefore, recognized as a continuing official adviser to the Federal Government and it must attempt to answer such questions of a scientific or technical nature as are officially submitted to it by members of government departments. A permanent channel of communication was thus created, but power to initiate traffic over it resides with the Government and no auxiliary machinery was created whereby the academy or any other civilian agency might take the initiative in bringing before the Government matters of scientific importance.

Less than a year prior to the entry of the United States into the first World War, a significant step was taken designed to facilitate the use of the channel of communication between Government and the National Academy. In 1916 the National Research Council was created by President Wilson, and a little later was to play a part in focussing civilian effort on the military problems then arising. The National Research Council was, and is to-day, a subsidiary of the National Academy of Sciences and, like the academy, is largely an advisory body only and awaits the assignment of problems by one or another branch of the Government before it can go seriously to work. Moreover, the council, like the academy, is not in possession of free money, a corporate laboratory and other research facilities and is, therefore, not well constituted to conduct research work on any extensive scale.

We turn our attention, therefore, to another agency contemporaneous with the National Research Council, which was created for the express purpose of establishing cooperative effort between military and civilian groups, and which was provided by Congress with funds necessary to create research facilities and to operate them when once created. This agency is the National Advisory Committee for Aeronautics, commonly known as the NACA. The law which created the committee provides that it shall "supervise and direct scientific study of the problems of flight, with a view to their practical solution," and also "direct and conduct research and experiment in aeronautics." The committee is composed of fifteen members, including two representatives each of the War and Navy Departments. Throughout its more than twenty-five years of existence, the NACA has given ample testimony of the fruitfulness of cooperation between military and civilian groups, and moreover has provided a prototype as to an organizational arrangement for effecting such cooperative effort successfully.

When, some two years ago, the group to whom I

have already referred became convinced that broader participation by civilian scientists in the whole military program was likely to be essential, they regarded the NACA as typifying the sort of organization they would like to see created. A plan was therefore drawn up envisaging a committee composed in part of civilian scientists and in part of Army and Navy representatives. On the one hand, the committee was charged with a broad study of the materials of warfare and, on the other, it would recommend and, if possible, initiate such research as they believed to be in the national interest.

The NACA was created in 1915 by an Act of Congress. The somewhat duplicative plan just referred to was submitted to President Roosevelt about a year and a half ago for such action as he saw fit to take. The proposal appealed to him and he decided to create the committee by Executive Order. This order established the committee as a division under the Office for Emergency Management and confers upon them power to take the initiative in many scientific matters which they believed to have military significance. It also directed the committee to develop broad and coordinated plans for the conduct of scientific research in the defense program, in collaboration with the War and Navy Departments; to review existing scientific research programs formulated by these departments, as well as other agencies of the Government; and advise them with respect to the relationship of their proposed activities to the total research program. Moreover, and this is especially important, the order directs them to initiate and support scientific research on the mechanisms and devices of warfare with the object of improving present ones, and creating new ones.

The order contemplated that the committee would not operate in the field already assigned to NACA nor in the advisory field of the National Academy of Sciences and National Research Council. Parenthetically, it might be noted that in this latter field the academy and council are currently engaged on advisory work for Government for which the out-of-pocket expenses alone are at the rate of much more than $1,000,000 a year. A recent count shows that the present personnel of Academy and Research Council advisory committees runs to about 225. These figures will give an idea of the vital part which these fact-finding groups are playing in the present emergency. But to be a little more specific I might mention that one important committee of the National Academy is advising the Office of Production Management on the availability of strategic materials.

In order to formulate adequate rules for the utilization of materials of whatever sort, accurate knowledge as to their availability, as to new processes suggested for producing them, as to possible substitutes, and a thousand and one other basic questions must be answered. This can only be done by highly trained scientists and engineers. Only after they have answered can the urgent problems or proper utilization be handled. The academy has assembled a group of the most distinguished men in the United States to give OPM this basic information.

Other examples are to be found in the services which the National Academy of Sciences and National Research Council are giving in advising the military departments on highly confidential matters; in the fact that the Medical Division of the National Research Council is the operating arm of the Medical Research Committee mentioned later, and in the service the council is furnishing in selecting technical personnel.

Thus, in June, 1940, the National Defense Research Committee, more familiarly known as the NDRC, was born. It was constituted of eight members, two of these being high-ranking men from the Army and Navy, respectively, five more being civilians well known for their experience in organizing and directing both fundamental and applied scientific research, and as an eighth member, the Commissioner of Patents.

The Executive Order creating the NDRC omitted any reference to the biological sciences, and, in particular, to the medical sciences. However, during its first year of operation, experience accumulated to the effect that a broader program of attack would not only be useful but was, in reality, urgently demanded. This realization prompted a second approach to President Roosevelt, with the result that in June of last year he created two new functional groups. One of these was the Committee on Medical Research, to explore its indicated territory in the same manner that the NDRC had been exploring the physical sciences. Then, over and above both the NDRC and the Committee on Medical Research, there was placed the Office of Scientific Research and Development, usually referred to as OSRD. This latter office was placed in charge of Dr. Vannevar Bush, who until then had been chairman of the NDRC. President Conant of Harvard was then made chairman of the NDRC and Dr. Newton Richards, of the Medical School of the University of Pennsylvania, was made chairman of the CMR.

In order to insure complete coordination of civilian and military research and development, Dr. Bush, as director of OSRD, was provided with an advisory council consisting of the chairmen of NDRC, CMR and NACA; the coordinator of naval research and the special assistant to the Secretary of War performing a somewhat similar function in that service.

The Executive Orders creating these various com-

mittees naturally had to leave indeterminate the question of financial support. They are all subsidiary to the Office for Emergency Management and, like this office, must look to Congress for the necessary operating appropriation. Thus far the appropriations, while not munificent, have been adequate. During its first year of existence the NDRC authorized research projects which totaled about ten million dollars. At the beginning of its second year, it was granted another ten millions and this was recently augmented by several millions more. To be more specific, the OSRD, during its first year of existence, will guide the expenditure of about twenty millions throughout the whole scientific field.

I should now like to take a few minutes of your time to explain the manner in which the expenditure of these funds is initiated and supervised. To begin with, let me point out that the work of the NDRC is divided into four major departments: Division A, of which Professor R. C. Tolman, of the California Institute of Technology, is chairman, deals with armor, bombs and ordnance, in general; Professor Roger Adams, of the University of Illinois, heads Division B on chemistry; Division C deals with transportation and communication and submarine warfare, and I am its chairman (this division operates the subsurface warfare laboratories); finally, Division D, which deals with instruments and numerous miscellaneous projects difficult to catalogue, is headed by President Compton, of the Massachusetts Institute of Technology. It is in this division that the micro-wave laboratory is organized.

To expedite discussions, surveys and the general handling of the work, a further breakdown has been found desirable, the result being that each division comprises several so-called sections. Division B on chemistry, under Professor Adams, is divided into thirty-one sections—which stands to date as a sort of record.

The work of a section is entrusted to a section chairman, who in turn calls to his aid certain individuals who become permanent members of his sectional committee and who are known technically as members. Then there are others who may be asked to render advice and assistance from time to time and hence are called consultants. Members and consultants are officially appointed by the chairman of the NDRC and are designated only after official clearance by the Army and Navy Intelligence and the FBI. Full consideration is therefore given to the basic requirements of the military services as regards the confidential handling of their problems. Because of its peculiar interest to you, I would note that the section dealing with communication problems is under the direction of Dr. Jolliffe, who is a vice-chairman of Division C.

Neither the five civilian members of the NDRC itself nor any of the section chairmen, members or consultants are paid from public funds. Without exception, they are loaned to the Government by their employing organizations and frequently the loan is complete, the work being so voluminous and detailed as to require a man's full time. Thus, when I tell you that about 500 of the leading scientists of the country are encompassed in the present NDRC organization, you will see that the Federal Government and even the forgotten taxpayer are getting a lot of valuable consulting talent free of charge.

So far as I have now outlined it, the functioning of the NDRC requires no public money except a very small amount for paid office assistants together with the traveling expenses of members and consultants. For the most part members and consultants do not carry on the research and development projects which the NDRC decides to promote—their duties are advisory and administrative. They formulate the problems which they believe it important to have undertaken, and then arrange with various scientific institutions to carry on the work. It is this last step which brings in the need for considerable sums of money. For instance, a project assigned to a particular university or industrial laboratory may require the full time of several of its faculty together with that of numerous younger men hired specifically for the work in hand.

The number of such projects now approved and, for the most part, contracted out to universities and industrial research laboratories stands around 600, while the number of contracting institutions is over 100; and when it is stated that the total value of the projects thus far determined upon is upwards of twenty million dollars, you will realize at once that the monetary resources of the scientific world would not be adequate to conduct the program on a gratuitous basis. The contracts vary all the way from those involving a few thousand dollars to those calling for two to three hundred thousand dollars per month. I have no doubt but that many of you here to-day are working either full or part time on one or more of these NDRC contracts.

The question is frequently asked as to how many technical people have been drawn into the civilian defense effort which the NDRC directs, but obviously this is quite difficult to estimate, let alone to enumerate in detail. I have already mentioned that there are about 500 scientists in the NDRC organization serving as members, consultants, etc. It seems likely that somewhere between two and three thousand scientists are at work on defense projects as employees of contractors with about an equal number of less highly skilled individuals assisting them as laboratory assistants, technicians, etc. Then, if the situation which

I know to exist at the Bell Telephone Laboratories is to be taken as a criterion, we must add to this scientific group another very considerable array of technical people who call themselves engineers as opposed to physicists and chemists—an array which if enumerated would no doubt total four to five thousand.

Recent figures from the Bell Telephone Laboratories might be of interest as perhaps typifying the situation found in a number of industrial laboratories which are fulfilling defense contracts, some for the NDRC and some directly for the Army and Navy. A rough count shows that about 600 of our technical staff are now engaged directly on a full-time basis on defense projects. When I say that they are "engaged directly" on defense projects, I am excluding those who by circumstances arising out of the defense program have been forced to devote themselves to such problems as the finding of substitute materials and the engineering of emergency telephone projects.

Another aspect of the NDRC plan of operation which I should like to stress is its "no profit" feature. This applies alike to contractors and to employees of contractors. Perhaps this point can be brought out most clearly by reference to a specific situation. The University of California is acting as a contractor to the NDRC on a large project which involves an annual expenditure of around one million dollars. Certain members of the California faculty are employed on a full-time basis on the project and in switching from teaching to defense work have incurred no change in rates of pay. The university has also hired from other faculties certain individuals to augment the defense staff and they, likewise, have gone over without changes of salary, although a payment is made to compensate for the cost of moving in the case of both single and married men. It is also stipulated explicitly that the university, as contractor, will derive no monetary profit from the work and the same requirement is exacted of industrial laboratories and other types of contractors.

The "no-profit no-loss" proposition has involved the adoption of certain more or less arbitrary but seemingly equitable rules of accounting. Thus, a university is usually allowed an overhead payment amounting to 50 per cent. of the salaries which it pays to its members employed on a defense project. Similarly, an industrial laboratory, by virtue of the fact that it has to operate with commercial capital and is subjected to a variety of forms of taxation from which the university is exempt as well as other expenses, is allowed an overhead of 100 per cent. of the salary item.

I suppose it depends upon one's point of view as to whether the effort I have just outlined appears large or small. On the one hand, it seems fairly certain that it is only a beginning and must expand further. On the other hand, it is certainly large already when contrasted with any civilian effort which was able to assert itself during the last war. And looking back to the situation which existed a quarter of a century ago, it is difficult to understand why the then available civilian agencies were not unleashed to an extent commensurate with their obvious capabilities. True, the National Research Council was created to assist with the solution of defense problems, but it was, as I have pointed out, in the position of a doctor waiting for clients; it could not adopt the attitude of an aggressive salesman and initiate attacks on what it regarded to be important military problems. Hence we can declare that as regards organization notable progress has been made.

As to future expansion of our civilian defense effort, it is becoming increasingly essential to bear in mind the potential shortage of trained personnel. Without insinuating anything as to guilt, the chemists declare that this is a physicist's war. With about equal justice one might say that it is a mathematician's war. The visible supply of both physicists and mathematicians has dwindled to near the vanishing point, consistent with the maintenance of anything like adequate teaching staffs in our universities. If this civilian defense effort is to expand, and such indeed now seems imperative, the limiting factor may therefore be a shortage of highly trained individuals and not a shortage of financial aid.

This leads me to state a few general observations concerning the past and future of our work. It is quite apparent that to date the burden of NDRC contracts bears much more heavily upon some institutions than upon others. At the outset this has necessarily been the case. While serious attention has at all times been given to the subdivision of projects so that they could be farmed out as widely as possible, a limit is frequently reached beyond which it isn't practicable to go in the matter of division. And in many cases, no division at all could be entertained, a situation that has given rise to a few large contractors, of which I cited the University of California as an example.

In the assignment of the early contracts, it has been natural, in fact essential, to lean heavily upon those institutions, both academic and industrial, which for one reason or another have been peculiarly fitted to transfer quickly from peace-time to war-time problems. This has been done with a view to conserving time. But the stages of the program to follow will doubtless involve a broader survey of the situation to find locations where new problems can be lodged with a minimum of interference to essential defense work

and teaching now in progress. In this survey a guiding principle will be to utilize men and facilities *in situ* whenever possible, thus preserving the "going value" of groups who are accustomed to working together. In the face of crises, the human tendency is usually to do the reverse, it being so easy for central agencies to ignore established but not well-known organizations, and attempt to cope with an emergency by calling workers from right and left to some new location. As a matter of fact, this tendency was beginning to make an appearance even as long as two years ago, when the fundamental plan of the NDRC was under discussion. Had the tide then setting in been allowed to run on for some months unimpeded, the result would inevitably have been a literal army of uprooted scientists in Washington and other central points, sitting around idly waiting for vast amounts of research equipment which had been placed on order, but was not much nearer materialization than that, to be installed in hastily constructed laboratories. This would have been the easy and disastrous way. Fortunately the creation of the NDRC came in time to stem such a tide.

Another present problem, and it is the last with which I shall trouble you, is one which by its existence supplies evidence that real progress has already been made in some of the research programs thus far initiated. It has to do with shortening the time gap between proven laboratory research results and the stage where mass production can be undertaken. Some of the laboratory results already achieved hold such promise that every day which intervenes before their wide-spread utilization becomes a serious matter. Obviously the problems to be met here cover a wide range of equipment and materials—as wide as that marked out by the scientific results themselves—and since they involve large-scale manufacture, the whole plan must be carefully worked out with other official agencies, particularly the Office of Production Management and the armed services. I am sure, however, that we are prepared to meet and solve these problems, and rather than be concerned with the difficulty of making progress along this avenue, I think all who are guiding the work of the NDRC would exclaim to the ranks of scientists and technicians, "Bring on your results, the more the better, and we will guarantee them a speedy passage to the firing line!"

In the foregoing, I have attempted merely to sketch the set-up of organized civilian research and development created for the war emergency. Obviously, it is only a part of the total effort which is being mobilized. It would be unfair to thousands of scientists and engineers to infer that the main results were dependent on the work of these agencies.

The scientific departments of the armed services are being greatly enlarged; industrial laboratories are turning more and more of their efforts to direct and indirect war work and engineers everywhere are active. Fundamental and applied science are on the march.

OBITUARY

HARRY WARD FOOTE

It is with real recognition of the responsibility which is placed upon the writer, a colleague of Harry Ward Foote in the department of chemistry in Yale University, that this report is made. This academic association covered a period of forty-two years of collegiate activity. Hundreds of graduates of the Sheffield Scientific School who enjoyed the privilege of studying chemistry under this inspiring teacher will be grieved to learn of his sudden death on January 14, 1942, in the New Haven Hospital. There were only eight days difference in the ages of Professor Foote and the writer, and we both grew up together in the atmosphere of Yale, and were taught by the same group of inspiring Yale teachers in chemistry: Professor Horace L. Wells, analytical chemistry, Professor William G. Mixter, general chemistry, and Professor Samuel G. Penfield, mineralogy.

Harry Ward Foote will be remembered as a most successful teacher in his special subjects, namely—general and analytical chemistry. He was the kind of a teacher that every American college boy should come in contact with during his academic or collegiate career. He endeared himself to his undergraduate students; he tried to understand each individual man in his class; he played fair with them, and the student was impressed with his spirit of fairness and square dealing. He was a sane thinker, not given to making snap decisions; his advice was sound and helpful. He exercised vigilance and conservatism in the trying days of Yale's reorganization of the university's departments of chemistry, and was recognized for his safe counsel and departmental cooperation.

Professor Foote's courses in chemistry laid an excellent and sound foundation for future growth; widened the student's knowledge and outlook, and encouraged many to get scientific training for themselves. Not only the student body suffers a real loss in the death of Professor Foote, but also the general faculty and departmental staff of the Sheffield Scientific School. He was recognized by his teaching associates as a good representative of democracy, a believer in freedom of speech, thought and action, as long as no infringement was made on the rights of others.

He was an excellent companion with a variety of personal interests and always a man of stability.

Collegiate institutions have learned to rate at its true worth the teaching service of men like Professor Foote, and their ability to give sound training in special fields of science. We need more than ever during these critical times young men who can apply successfully the technique of sound pedagogics. This calls for the ability to inculcate habits of keen observation and deduction; to teach the essential facts having a direct bearing on the activities of everyday life, and stimulate progressive thought during the next fifty years.

Harry Ward Foote was born in Guilford, Connecticut, on March 21, 1875. He received his degree of Ph.B. from Yale in 1895, and his Ph.D. degree from Yale in 1898. He was appointed an instructor in 1898 and served as assistant professor of chemistry from 1904–1912, and as professor of chemistry from 1912 to the time of his death. He was a fellow of Silliman College, a member of the scholastic Society of Sigma Xi and an honorary member of Chi Chapter of the chemical fraternity, Alpha Chi Sigma. He was a member of the following scientific societies, namely —American Chemical Society, Connecticut Academy of Arts and Sciences and the Royal Geographical Society. For several years he was associate editor of the *American Journal of Science*.

TREAT B. JOHNSON

YALE UNIVERSITY

PAUL STILWELL McKIBBEN

1886–1941

DR. PAUL S. MCKIBBEN, until recently dean of the School of Medicine, University of Southern California, was born in Granville, Ohio, on March 14, 1886, and died in Los Angeles, California, on November 11, 1941. His parents were George F. McKibben, professor of Romance languages in Denison University, and Elizabeth Stilwell McKibben, a graduate of Wellesley College, a very kindly and strong character. Paul McKibben's education was obtained in the public schools of Granville, Doane Academy and Denison University, where he was graduated in 1906, a bachelor of science with honors in zoology. He was appointed a fellow in anatomy in the University of Chicago in October, 1907. Professor C. Judson Herrick, who had been professor of biology in Denison University before going to the University of Chicago, was a great friend of the elder McKibbens. This friendship was shared by the younger McKibben when he went to Chicago, and under Herrick's direction and kindliness, McKibben's scientific qualities developed. This resulted in the production of one of the great anatomists, teachers and administrators of this generation. Paul S. McKibben received the degree of doctor of philosophy in June, 1911, and was immediately made instructor in anatomy at the University of Chicago.

In 1913 Dr. McKibben was offered and accepted the professorship in anatomy at the University of Western Ontario. The department of anatomy soon became the outstanding department of the Medical School. From March, 1918, for one year, Dr. McKibben was first lieutenant in the U. S. Army attached to the Neuro-Surgical Laboratory of the Johns Hopkins University where, in association with others, he did some original work on brain injuries. On his return to the University of Western Ontario, he was appointed acting dean and, because of his outstanding administrative abilities, was soon made dean. A new Medical School building was constructed largely through Dr. McKibben's efforts. Even the design was his, and it is considered one of the finest and best-equipped medical buildings in Canada. Dr. McKibben realized the advantages of a good library with the result that the University of Western Ontario Medical Library now has over 30,000 volumes. The School of Public Health was established during his deanship, mainly through his efforts. His work at the University of Western Ontario was a major factor in the development of one of the outstanding medical schools in Canada. He was very strong for the integration of primary subjects with the clinical.

In 1927 Dr. McKibben was appointed professor of anatomy at the University of Michigan, where he remained for two years. He was called in 1929 to the chair of anatomy in the newly established Medical School of the University of Southern California. In 1931 he was made dean of the School of Medicine but continued as chief of the department of anatomy. Here again his great administrative ability came to the fore and he gathered together a fine group of teachers in both the pre-clinical and clinical years.

Dr. McKibben's knowledge of medicine in general was tremendous. His ability to pick students was uncanny. He combined the qualities of a great mind with those of an outstanding teacher and administrator and, above all, was a tolerant and understanding friend to many fortunate people. Dr. McKibben was given the honorary degree of LL.D. from the University of Western Ontario in 1928 and Sc.D. from Denison University in 1936. He was a fellow of the Royal Society of Canada, the American Association of Anatomists, the American Association for the Advancement of Science, and was a member of Beta Theta Pi, Gamma Alpha, Phi Rho Sigma, Phi Beta Kappa and Sigma Xi. He leaves his widow, Elizabeth Kendall McKibben, whom he married at Baltimore while doing research at the Johns Hopkins University, four children, Paul Stilwell, Jr., Richard Ken-

[K]all, John H. and Elizabeth, as well as a host of tremendously loyal and admiring friends.

JOHN MACKENZIE BROWN

SCHOOL OF MEDICINE,
UNIVERSITY OF SOUTHERN CALIFORNIA

DEATHS AND MEMORIALS

DR. HERBERT FOX, professor of comparative pathology at the University of Pennsylvania and director of the William Pepper Laboratory of Clinical Medicine, died on February 27 in his sixty-second year.

REGINALD PELHAM BOLTON, consulting mechanical engineer; president and chairman of the board of the Electric Meter Corporation, New York City, died on February 18 in his eighty-sixth year.

DR. JAMES JOSEPH WALSH, professor of physiological psychology at Cathedral College, New York, and medical director of the School of Sociology at Fordham University, died on February 28 in his seventy-seventh year.

DR. PARKE REXFORD KOLBE, president of the Drexel Institute of Technology, Philadelphia, died on February 28, at the age of sixty years.

Two Eggleston Prizes in botany at Dartmouth College have been established in memory of Willard W. Eggleston, an authority on plants poisonous to stock on the western ranges of this country.

A CEREMONY in memory of Polish professors who lost their lives as a result of the German occupation of Poland recently took place at the Royal Institution, London, under the presidency of Sir David Ross, vice-chancellor of the University of Oxford. Tribute to their work was paid by Sir William Bragg, formerly president of the Royal Society; by Professor Gilbert Murray, of the University of Oxford, and by Professor Antoni Jurasz, dean of the Polish Medical School at the University of Edinburgh.

SCIENTIFIC EVENTS

NATIONAL PARKS AND RESERVES IN GREAT BRITAIN

A PRELIMINARY memorandum on "Nature Preservation in Post-War Reconstruction" has been issued in Great Britain by a conference which, under the chairmanship of Lord Onslow, has been considering the matter since June. It is stated in the account given by the London *Times* that the conference came into being as a result of the announcement that Lord Reith had appointed a committee on the use of land in post-war planning. The organizations taking part are the following:

Association of Municipal Corporations, British Association, British Ecological Society, British Museum (Natural History), British Ornithologists' Union, British Trust for Ornithology, County Councils Association, Geological Society, Linnean Society, Royal Entomological Society, Royal Society for the Protection of Birds, Society for the Preservation of the Fauna of the Empire, Society for the Promotion of Nature Reserves, Urban District Councils Association and Zoological Society.

The memorandum states that there are three distinct needs—the preservation of (*a*) rural amenities; (*b*) forest areas as a part of the nation's resources; and (*c*) the natural fauna and flora for the advancement of scientific knowledge and education. In the view of the conference there are four ways in which these needs can be met:

1. National parks, providing facilities for the recreation of the public with no more restriction than is essential to preserve their amenities.
2. Forest and wild life reserves, to which the public would be admitted, subject to necessary restrictions.
3. Areas in which further development would be prohibited or drastically restricted. Here the existing movement of the public would not be interfered with, but additional facilities would not be provided.
4. Nature reserves or sanctuaries, from which the public would be excluded, except by permit for study.

It is pointed out in the *Times* that in some instances all these needs could be met in the same area. Areas of the first three types must be large. Those of the fourth type could be much smaller, usually measurable in hundreds or tens of acres, or even less. The conference makes the recommendation that "The provision of such areas should be among the matters comprised in National Planning."

The later part of the memorandum gives more detailed consideration of each type of area, and in regard to the first urges that the recommendations of the "Report of the National Park Committee," issued by the Stationery Office in 1931, should be put into effect.

Nature reserves should be selected upon an ecological basis, and should be of different types, such as fen, moorland, mountain, cliff, beach, woodland, and so forth, so that the typical animals and plants of each kind of country would be preserved. Some of these reserves could form part of the larger schemes for national parks and areas protected from development.

An official body should be appointed to draw up detailed proposals upon this highly technical problem of nature reserves, the control of which should be in the hands of a central body. The management of the national parks might, it is suggested, be in the hands of local bodies, acting under two national park

authorities (one for England and Wales and the other for Scotland) responsible for general policy.

The conference remains in being. Its honorary secretary, Dr. G. F. Herbert Smith, Society for the Promotion of Nature Reserves, British Museum (Natural History), London, S.W.7.

CHEMICAL ABSTRACTS

Chemical and Engineering News gives the following account of the work of *Chemical Abstracts*, published by the American Chemical Society:

In spite of war *Chemical Abstracts* published more abstracts in 1941 than in 1940. The small increase (505 abstracts) is to be attributed to success during 1941 in the abstracting of European chemical patents after overcoming difficulties which interfered with this abstracting for a considerable period after the outbreak of war in Europe. The 1941 volume contained 5,541 more abstracts of patents and 5,036 fewer abstracts of papers than in the 1940 volume. The abstracts for 1941 total 52,764 in number as contrasted with 52,259 abstracts published in 1940. Of the 1941 abstracts 35,588 are of papers and 17,176 are of patents.

Chemical Abstracts endeavors to cover the chemical literature of the world completely. World-wide warfare presents many serious handicaps in this effort. *Chemical Abstracts* did not approach completeness so closely in 1941 as in normal years. Nevertheless, the record for 1941 is good. Abstracts from many of the papers published during 1941 in the warring or conquered European countries were obtained by some success in getting the needed periodicals (good success until Russia's entry into the war closed the trans-Siberian route), by searching this country for periodicals received in one library or another, and by having abstracts made in Europe, particularly in Switzerland and Germany, and sent by clipper ship.

In general, the policy of *Chemical Abstracts* is to publish informational rather than merely descriptive abstracts. Special emphasis has been placed on this for European and other publications not readily accessible to most Americans at the present time. The average page of *Chemical Abstracts* in 1941 contains 11.5 abstracts of papers or 18.6 abstracts of patents. The corresponding figures for 1940 are 12.1 and 18.0, respectively.

The edition of *Chemical Abstracts* averaged approximately 15,000 copies during 1941.

The much-used list of periodicals abstracted by *Chemical Abstracts*, with its key to library files, is normally published in revised form every five years. The list was due for revision in 1941, but the war has made postponement necessary. Satisfactory revision with American libraries in their present war-handicapped condition is not possible. The *Chemical Abstracts* office is keeping as well informed as possible concerning scientific periodicals and is willing to help users of abstracts locate full papers whenever possible. Hundreds of inquiries are answered monthly.

The only editorial change during the year was the well-earned elevation of Charles L. Bernier to an associate editorship following the regretted resignation of Janet D. Scott, who left to join the Chemical Warfare Service staff at Edgewood, Md. Miss Scott is continuing to help in the naming and indexing of inorganic compounds. The editor gratefully acknowledges the valuable help of all of the assistant editors and abstractors, many of whom are continuing their work for *Chemical Abstracts* in spite of heavy national defense assignments. Our work is regarded as being in the same category.

THE FEDERATION OF AMERICAN SOCIETIES FOR EXPERIMENTAL BIOLOGY

THE Federation of American Societies for Experimental Biology will meet in Boston from March 31 to April 4. The general chairman of the meeting is Dr. Albert G. Hogan, University of Missouri, and the general secretary is Dr. Donald R. Hooker, the Johns Hopkins University. The following table gives the date of meeting of the constituent societies, and the names of the presidents and secretaries.

SOCIETY	PRESIDENT	SECRETARY
	April 1 to 2	
American Institute of Nutrition	Dr. Albert G. Hogan University of Missouri	Dr. Arthur Smith Wayne University
	April 2	
American Physiological Society	Dr. Philip Bard The Johns Hopkins University	Dr. Carl J. Wiggers Western Reserve University
	April 2 to 4	
American Society of Biological Chemists	Dr. Rudolph J. Anderson Yale University	Dr. Arnold K. Balls George Washington University
	April 2 to 4	
American Society for Pharmacology and Experimental Therapeutics	Dr. E. M. K. Geiling University of Chicago	Dr. Raymond N. Bieter University of Minnesota
	April 2 to 4	
American Society for Experimental Pathology	Dr. Jesse L. Bollman Mayo Clinic, Rochester, Minn.	Dr. H. P. Smith State University of Iowa

PHI LAMBDA UPSILON

THE results of the recent election of the national officers of Phi Lambda Upsilon, honorary chemical society, are announced in the January issue of the *Register*, the official publication of the society. Professor William M. Sandstrom, of the department of agricultural biochemistry of the University of Minnesota, was reelected president. Professor T. F. Buehrer, head of the department of agricultural chemistry of the University of Arizona, and for twelve years national secretary-treasurer, was elected to the vice-presidency. Both men have long been identified with the national activities of Phi Lambda Upsilon.

Professor L. F. Audrieth, of the University of Illinois, was reelected editor of the *Register*. Dr. C. S. Carlson, assistant professor of chemical engineering at the University of Pennsylvania, and Professor Herschel Hunt, of Purdue University, were chosen for the offices of secretary and treasurer, respectively.

Phi Lambda Upsilon has enjoyed a remarkable growth since it was founded at the University of Illinois in 1899 as a society for the promotion and recognition of high scholarship and achievement in the field of chemistry. Only seven collegiate honorary organizations antedate the founding of Phi Lambda Upsilon. There are now thirty-eight chapters with an active and alumni membership exceeding 11,000.

For many years Phi Lambda Upsilon has recognized outstanding American investigators by election to honorary membership. During the past year two distinguished chemists have been awarded this distinction—Dr. Linus C. Pauling, director of the Gates and Crellin Laboratory at the University of California and Nobel Laureate, and Professor William Lloyd Evans, retired head of the department of chemistry at the Ohio State University and president of the American Chemical Society.

THE CHARLES FREDERICK CHANDLER MEDAL OF COLUMBIA UNIVERSITY

For outstanding achievements in chemical science, Dr. Robert R. Williams, chemical director of the Bell Telephone Laboratories, New York, and Dr. Roger J. Williams, of the University of Texas, received on February 26 awards of the Charles Frederick Chandler Medal of Columbia University. This is the first double award of the medal since it was established in 1910.

Dr. Robert R. Williams was cited for "his years of work on the isolation of vitamin B_1 and his contributions to the elucidation of its chemical structure." Vitamin B_1, which Dr. Williams synthesized and named thiamin, is the antineuritic beriberi vitamin, vital to nerve health and life.

The award to Professor Roger J. Williams was made in recognition of his discovery of pantothenic acid, powerful regulator of growth popularly known as "the acid of life," and for his contributions to the knowledge of the vitamin B complex.

The medal ceremony was held in the Horace Mann Auditorium. Dr. George B. Pegram, dean of the Columbia Graduate Faculties, presented each recipient with a certificate in lieu of a gold medal, presentation of which will be postponed until after the war. The university, as part of its conservation policy, has discontinued striking bronze, silver or gold medals during the war period.

Vitamins will increase intelligence and morality as well as give people better physical and mental health, was stated by Dr. Roger J. Williams in a joint discussion on "Vitamins in the Future." He pointed out that "Since an ample supply of vitamins can foster a higher intelligence in human subjects, it has also the capability of fostering morality. Recent studies, several of them in New York City, have shown without question that intelligence and morality go together."

Discussing novel approaches to the treatment of diseases by chemical means, Dr. Roger Williams described a new "definite guiding principle" that chemists may follow in their investigations. He said:

It seems a reasonable working hypothesis to assume that chemical substances which have striking physiological effects have these effects because of their resemblance to naturally occurring tissue constituents. Continuing, we may assume that many substances of potential therapeutic value will be found which bear chemical resemblances to the various vitamins, of which we now have a considerable variety.

If these remarks are valid, chemotherapy can now develop, not in a hit-and-miss and entirely empirical fashion, but by making use of at least one definite guiding principle.

One of the most important applications of vitamin knowledge will be, I believe, to the study of cancer. Our work as well as that of others indicates that the vitamins in the diet make a difference in cancers other than those induced by butter-yellow.

All the vitamins which are required to check the great nutritional plagues of mankind have already been discovered and produced commercially. Dr. Robert Williams stated that:

The lesser vitamins, if we may call them such for the sake of brevity, may afford us, however, great revelations regarding physiological and even pathological processes and so must be classified as lesser only in a narrowly defined sense.

The point in distinguishing between major and lesser vitamins is one which concerns present-day technology, present-day economics and present-day sociology. I should like to divert the minds of food processors, teachers of nutrition, practicing physicians and laymen from speculating about the latest surmise of vitamin science and persuade them to devote their major energies to the intelligent application of the vitamins which stand in the front row on the shelf.

It is high time we should be systematically eradicating the long known deficiency diseases. The first impulsion of our present knowledge of vitamins and their essential roles should be to promote restoration of values lost to the masses by these restrictions. A general removal of economic restraints would largely achieve the result because appetites lead to diversity when income permits.

This, however, is a Utopian ideal far beyond our immediate reach. Education, if universal, would largely accomplish the result, for avoidance of refinement is not inherently costly. However, education of the most needy

elements is exceedingly slow and difficult. We must, therefore, turn to more effective weapons as soon as education has pervaded the public mind sufficiently to permit their employment.

Legislation in the United States prohibiting the sale of impoverished white bread and flour is a possibility. Undoubtedly any attempt to prohibit the sale of white wheat products in the United States would meet with insuperable public opposition. However, it is now possible to add artificially the principal valuable vitamins and minerals of wheat at a cost of something less than twenty-five cents per capita per annum.

Increased economic productivity of the bulk of the population would repay the cost perhaps a thousand-fold to say nothing of improved health and sense of well-being. Yet this great reform is being sabotaged or damned with faint praise by half the nutritionists of the country on the ground that it would be still better if we could arrange breakfasts of ham and eggs, whole wheat buns and a glass of milk for everybody. Of course it would, but shall we wait for the millennium to take our first steps to mass repair of our nutritional errors?

Pending the day when such legislation can be secured and the necessary scientific methods of control are developed, we must look largely to the food industries for correction of our dietary faults. These industries have been made very conscious of their public obligations, to a great extent through the operation of the pure food laws during recent decades. Within the limits of practicality, they are in general ready to cooperate in such reforms on a voluntary basis.

You are doubtless asking what all this vitamin knowledge will get us in terms of health, strength and longevity. No quantitative estimates are possible. Very few long-term experiments with animals have been carried out since all the major vitamins became available in pure form and since several of the lesser ones have been at least recognized. The testimony of the clinics, the results of experiments with school lunches or supplementary feeding, as well as the observation of health trends in nutrition-conscious populations, are very reassuring.

Since partial deficiencies are often most apparent in middle or later life when the body mechanism is beginning to feel the strain of the years, it seems reasonable to hope that nutritional reform will extend the span of life measurably. Control of infectious disease has principally affected mortality in infancy and early life. Those who survive to old age tend to be those who have acquired immunity to infectious disease or at least to have undergone a selection for resistance to disease. In nutritional disease, the phenomenon of immunity is absent. We do not grow accustomed to deficiencies with the years. Early damage remains and later damage accumulates till the slowing bloodstream of age leaves our cells grossly undernourished, so it seems.

When nutritional reforms have been in full operation for some years, the physician will have little occasion to treat deficiencies of the major vitamins. Until that happy day, which must be some years hence, he will encounter an abundance of avitaminoses, especially in clinics for the under-privileged. His immediate task is to recognize the symptoms.

SCIENTIFIC NOTES AND NEWS

THE American Education Award of the American Association of School Administrators was presented on February 24 at the San Francisco meeting to Dr. Robert A. Millikan, chairman of the Executive Council of the California Institute of Technology, as "a tribute to and in recognition of outstanding contributions made in the broad field of education."

THE Longstaff Medal of the Chemical Society of London has been awarded to Dr. Hugh S. Taylor, David B. Jones professor of chemistry and chairman of the department at Princeton University. The medal is conferred every three years upon a fellow of the society "who, in the opinion of the council, has done the most to promote the science of chemistry by research."

THE Wollaston Medal of the Geological Society, London, has been awarded to Professor R. A. Daly, Sturgis Hooper professor of geology in the Museum of Comparative Geology at Harvard University, "in recognition of his fundamental researches in many branches of geology, especially those concerned with the origin of igneous rocks, the constitution of the interior of the earth and the controls of coral-reef formation."

THE *Journal* of the American Medical Association reports that Dr. Juan P. Garrahán, a pediatrician of Buenos Aires, has been awarded the 1941 prize of the Academia Nacional de Medicina of Buenos Aires for his article on "Prothrombin, Vitamin K and Hemorrhages in New-born Infants." The prize was established by the academy in memory of the Argentine pediatrician, Dr. Juan Carlos Navarro, who died in 1936.

PRESENTATION of the gold medal of the Society of Women Geographers was made on February 23 at the annual meeting of the society in New York to Dr. Margaret Mead, assistant curator of ethnology at the American Museum of Natural History.

OFFICERS of the Society of Economic Paleontologists and Mineralogists have been elected as follows: *President,* Herschel L. Driver, Standard Oil Company of California, Los Angeles; *Vice-president,* Parker D. Trask, U. S. Geological Survey; *Secretary-Treasurer,* H. B. Stenzel, University of Texas.

PROFESSOR RAYMOND E. DAVIS, of the College of Engineering of the University of California, was installed as president of the American Concrete Insti-

tute at the close of the Chicago meeting. He succeeds Admiral Ben C. Morell, of the United States Navy.

AT Fordham University, the Reverend Francis W. Power, S.J., has been promoted to a professorship in chemistry.

DR. ROBERT H. SHULER, of the University of Chicago, has been appointed assistant professor of physiology at the School of Medicine of the University of Georgia.

DR. RONALD F. BROWN, instructor in chemistry at Purdue University, was promoted to an assistant professorship of organic chemistry at the beginning of the second semester of the University of Southern California.

DR. JAMES L. MORRISON, instructor in pharmacology at the West Virginia University School of Medicine, has been appointed instructor in pharmacology at the Medical School of Emory University.

DR. ELSIE S. L'ESPERANCE has been placed at the head of a new cancer-prevention clinic for women at the Memorial Hospital for the Treatment of Cancer and Allied Diseases, New York. She is a member of the board of managers of the hospital and is one of the founders of the Kate Depew Strang Tumor Clinic at the New York Infirmary for Women and Children.

DR. LEONA BAUMGARTNER, pediatrician, who has been acting director of the Bureau of Child Hygiene of the New York City Health Department, became director of the bureau in January.

THE Borden Vitamin Company announces that Dr. Hugh H. Darby, research assistant in the department of biochemistry of the College of Physicians and Surgeons of Columbia University, has joined the staff for research and development in the production and application of vitamins and hormones.

DR. ROBERT S. BREED, head of the division of bacteriology of the New York State Agricultural Experiment Station at Geneva, has leave of absence in order to conduct a survey of dairy research and education in South America for the Inter-American Committee for the Dairy Industry.

MEMBERS of the faculty of the University of Michigan who are serving under the National Defense program include in the sciences: Elmore S. Pettyjohn, associate professor of chemical and metallurgical engineering; Walter C. Sadler, professor of civil engineering; Jesse Ormondroyd, professor of engineering mechanics; Robert B. Hall, professor of geography; Preston E. James, professor of geography, and Samuel A. Goudsmit, professor of physics.

DR. MAXWELL E. LAPHAM, dean of the School of Medicine of Tulane University of Louisiana, has left for Washington to work in the Bureau of Medicine and Surgery, U. S. Navy. In his absence Dr. Hiram W. Kostmayer, director of the department of graduate medicine, has been appointed acting dean.

DR. W. R. HUTCHERSON, head of the department of mathematics at Berea College, Kentucky, has been granted leave of absence which he is spending at Brown University on a defense mechanics fellowship. His work at Berea College will be carried on by Professor D. W. Pugsley; Dr. Waldemar Noll, head of the department of physics, is teaching in the College of the City of New York.

DR. WILLIAM J. ROBBINS, of the New York Botanical Garden, gave on February 26 a lecture before the Lancaster Branch of the American Association for the Advancement of Science. His lecture, which was illustrated with colored motion pictures, was entitled "Plant Life in a Botanical Garden."

DR. DONALD D. VAN SLYKE, of the Rockefeller Institute for Medical Research, New York City, and Dr. Warfield T. Longcope, professor of medicine at the Johns Hopkins University, gave the Abraham Flexner lectures at the School of Medicine of Vanderbilt University. Dr. Van Slyke spoke on the "Physiology of the Kidney" and "Renal Function in Diseases of the Kidney" on February 2 and 3, and Dr. Longcope on "Clinical Nephritis" on February 5 and 6.

A SYMPOSIUM entitled "What Is Research?" was presented on February 20 at a meeting in New York City of the American Section of the Society of Chemical Industry, held jointly with the American Institute of Chemical Engineers. Dr. Lincoln T. Work, director of research of the Metal and Thermit Corporation, presided over the meeting and introduced the subject "Research," which was discussed "from the Consultant's Viewpoint" by Frank G. Breyer, of Singmaster and Breyer; "from the Industrial Viewpoint" by Dr. George O. Curme, Jr., vice-president of the Carbide and Carbon Chemicals Corporation; and "from an Institutional Viewpoint" by Dr. L. W. Bass, assistant director of research at Mellon Institute.

THE thirteenth annual meeting of the American Association of Physical Anthropologists will be held at Harvard University on April 16, 17 and 18. Two symposia are planned, one for Thursday on "Fossil Man and Primates" and one on Friday on "Techniques and Interests of Physical Anthropologists." The annual dinner will be given on Friday, and will be followed by a motion picture of Point-Hope Eskimos which will be presented by Dr. H. L. Shapiro.

THE three hundred and eighty-sixth meeting of the American Mathematical Society will be held at Columbia University, New York City, on Friday and Sat-

urday, April 3 and 4. On Friday afternoon, there will be a symposium on topics in the theory of functions, consisting of two addresses, "On Entire Functions of Exponential Type," by Dr. R. P. Boas, of Duke University, and "On the Zeros of the Derivatives of a Function and Its Analytic Character," by Professor George Polya, of Smith College. The discussion leaders are Professors Norman Levinson, of the Massachusetts Institute of Technology, and I. J. Schoenberg, of the University of Pennsylvania. A symposium on aeronautics is being arranged for Saturday afternoon. One of the speakers will be Dr. Theodore Theodorsen, of Langley Field, Virginia, whose subject is "Theory of Wing Flutter." The discussion leader will be Professor Willy Prager, of Brown University.

The next general meeting of the International Association for Dental Research will be held in the Commodore Hotel, New York City, on March 14 and 15. It will be followed by a meeting of the American Association of Dental Schools which will be held on March 16, 17 and 18.

An examination for appointment as assistant sanitary engineer in the Regular Commissioned Corps of the U. S. Public Health Service will be held at Washington, D. C.; Cincinnati, Ohio; New Orleans; Kansas City and San Francisco, at 9 A.M. on May 11. Candidates must be not less than twenty-three years nor more than thirty-two years of age on that date and must have had at least seven years of educational (exclusive of high school) and professional training, or experience equivalent thereto; and shall have graduated from a reputable professional school granting a degree in engineering (sanitary engineering course). In addition the applicant will be required to pass a satisfactory physical, academic and professional examination. Commissioned officers are not appointed to any particular station, but to general service. They are subject to change of station as the exigencies of the service may require and shall serve wherever assigned to duty. Compensation, including allowance for quarters and subsistence, will be $3,158 and $2,699 for officers with and without dependents, respectively.

The American Library Association has established a Committee on Aid to Libraries in War Areas, with John R. Russell, librarian of the University of Rochester, as chairman. After the first World War there was difficulty in completing foreign institutional sets of American scholarly, scientific and technical periodicals. The attempt to avoid a duplication of that situation is now the concern of the committee. Many sets of journals will be broken by the financial inability of the institutions to renew subscriptions. Many more will have been broken through mail difficulties and loss of shipments and the destruction of libraries. The size of the eventual demand is impossible to estimate. In so far as possible, sets will be completed from a stock of periodicals being purchased by the committee. With an imminent paper shortage, attempts are being made to collect old periodicals for pulp. Fearing this possible reduction to the already limited supply of scholarly and scientific journals, the committee hopes to enlist cooperation to prevent the sacrifice of this type of material. Information in regard to the project can be obtained from Wayne M. Hartwell, executive assistant to the Committee on Aid to Libraries in War Areas, Rush Rhees Library, University of Rochester, Rochester, N. Y.

The Science-Technology group of the national Special Libraries Association has undertaken to compile, for the benefit of users of the Russian scientific and technical periodicals, current or otherwise, a complete list of the holdings of such periodicals in all the libraries of the United States and Canada, so far as possible, whether personal, institutional or industrial. Owners and librarians in charge of such materials are asked to cooperate by sending a detailed statement of their holdings to Miss Nathalie D. Frank, 512 West 162nd Street, New York City. It should be stated whether or not the journals can be borrowed on interlibrary loan and whether the library has facilities for photostating or microfilming.

The Executive Committee of the National Parks Association met recently in Washington and agreed upon the importance of carrying on its educational program. It is planned to continue advocacy of National Primeval Parks as a distinct category, to promote worthy park projects that have already been authorized, to encourage appreciation and proper use of America's natural and historic heritage, to combat each threat of commercial encroachment upon our protected reservations, and to divert destructive uses of all kinds from this country's superlative natural areas.

The newly established French School of Higher Learning has opened its courses in the building of the New School for Social Research. Professor Boris Mirkine-Guetzevitch gave his first lecture on the constitutional history of France, beginning with the French revolution; Professor Fred G. Heffherr spoke of the history of French civilization, and Professor Georges Gurvitsch, of French sociology. All lectures are given in French. The school has at present a faculty of letters and a faculty of law and a special institute of Oriental and Slavic studies. The faculty of science under Professor Jean Perrin will be organized later.

DISCUSSION

EXTENDED THEOREMS IN DYNAMICS

THE Faraday lines of force in any field of force constitute a familiar geometric pattern. Less well known because of its intrinsic complexity is the geometry of the trajectorial curves[1] (the paths of mass particles moving in the force field). Of course these two geometries should be related, but precisely how may we compare the two families of curves? This is what we propose to indicate.

Let a particle start from rest. The path obtained in this manner we shall call a "rest trajectory." Obviously this curve has the *same direction* as the Faraday line through the given point, but in general, since the mass particle has inertia, the two curves will *not coincide*. In fact, the only instance in which coincidence can occur is the trivial case in which both curves are straight lines. Omitting this possibility, there are always two distinct curves. The rest trajectory and the line of force will agree as to initial direction, but differ in initial curvature; the trajectory will be between the line of force and the common tangent line. The quantitative relation connecting the two curves is given in the following theorem discovered by Kasner in 1904 and since proved in many ways:

Theorem I:[1] *If a particle starts from rest in any positional field of force, the initial curvature of the trajectory is one third of the curvature of the line of force through the initial position.*

There are two important manners in which this proposition may be extended. The theorem is universally valid, but its significance is slight if the curvature of the line of force is zero at the point. If the curvature is zero, as for example at a point of inflection, the same is true of the curvature of the trajectory, and a separate discussion, involving a closer scrutiny of the situation, is necessary. In this case we study the ratio of the infinitesimal departure of the path and the line of force from the common tangent line. In the general case this ratio would be $1:3$ as stated above, because in the usual case the ratio of departures is the same as the ratio of curvatures. But in the special case of zero curvature, the ratio (which now depends on the rates of change of curvature) is found to be $1:5$, $1:7$, $1:9$, etc., depending on the order of contact of the line of force with the tangent line. The precise dependency is stated in Theorem II.

Theorem II:[2] *If the Faraday line of force has contact of order n with the tangent line, the rest trajectory will also have contact of n^{th} order; and the limiting ratio of the departure of the trajectory to the departure of the line of force from the common tangent line is* $1:2n+1$.

The second manner in which Theorem I may be generalized is to acceleration fields of higher order. A particle of unit mass is said to be moving in an acceleration field of order r if

$$\frac{d^r x}{dt^r} = \varphi(x, y) \qquad \frac{d^r y}{dt^r} = \psi(x, y)$$

where $\varphi(x,y)$ and $\psi(x,y)$ are the rectangular components of the higher acceleration field acting at the point (x, y) and t is the time. By definition, a particle will start from "maximum rest" in such a field if the initial velocity and the initial accelerations of order up to and including $r-2$ are zero (that is, all derivatives up to order $r-1$ vanish). What is the analogue of Theorem I for such higher fields?

Theorem III:[3] *If a particle starts from maximum rest in an acceleration field of order r, the initial curvature of the trajectory is* $\dfrac{r!\,(r-1)!}{(2r-1)!}$ *times the curvature of the line of force through the initial position.*

Now allow the particle to start from maximum rest in an acceleration field of order r, at a point at which the curvature of the Faraday line of force may be zero (the case in which Theorem III would no longer be significant). What is the appropriate ratio of departures?

Theorem IV: *In an acceleration field of order r, at a point at which the line of force has n^{th} order contact with its tangent line, the trajectory produced by starting a particle from maximum rest also has contact of order n with the tangent line; and the limiting ratio of the departure of the trajectory to the departure of the line of force from the common tangent line is* $\dfrac{(n+1)\,(r)\,!\,(nr)!}{(nr+r)!}$.

We see that all three situations previously discussed in Theorems I, II and III are now included in the single final Theorem IV. Indeed, the first three theorems become corollaries of this new result. For $r=2$, the newtonian case, the ratio is $1:2n+1$, as stated in Theorem II. For r arbitrary and $n=1$, the case in which the curvature does not vanish, we obtain the ratio of Theorem III, namely $\dfrac{r!\,(r-1)!}{(2r-1)!}$. And for $r=2$ and $n=1$, we have the standard dynamical Theorem I, with the usual ratio $1:3$.

All our theorems, although originally stated for two dimensions, remain valid for any number of dimensions, and in any riemannian space.

[1] E. Kasner, "Differential Geometric Aspects of Dynamics," Princeton Colloquium, 9, 1909, new edition 1934.

[2] *Idem, Proceedings of the National Academy of Sciences*, 20: 130–136, 1934.

[3] E. Kasner and D. Mittleman, *Proceedings of the National Academy of Sciences*, Feb., 1942.

Theorem I has been applied[4] to the study of the famous deviation problem (a particle falling from rest to the earth allowing for rotation or ellipticity). Our new extended theorems will also have applications, direct and indirect, in physical situations dealing with interacting particles. The forces need not be conservative.

EDWARD KASNER
DON MITTLEMAN
COLUMBIA UNIVERSITY

A STUDY OF LAMPBRUSH CHROMOSOMES BY THE ELECTRON MICROSCOPE

LAMPBRUSH chromosomes have been photographed by the electron microscope. The nuclei were removed from the oocyte according to the method of Duryee[1] and were placed on the collodion film suspended on the wire mesh which is used in place of the slide in the electron microscope. The nuclei were torn apart so that the enclosed material spread over the film. The membrane was then removed since it was too thick for penetration by the electron beam when collapsed. The preparation was allowed to dry in air.

The photographs seem to verify early descriptions. Some chromosomes appeared to be highly branched and subbranched. They were fern-like in appearance. The threads were crystalline and single. Other chromosomes showed less numerous, thicker, more globular side branches. Many side branches had been lost between the first and second type. Finally some showed no branches. There were as many as four threads twisting about one another separating into twos at some points and rejoining at others.

No loops, as described by Duryee, were seen. However, chromosomes from full-sized eggs only have been examined. Further investigations, in which the nuclei of half-sized eggs will be used, are in progress. It may be that these will verify the loop theory as put forth by Duryee.

Blanks were run in which only cell debris, from which the nucleus had been removed previously, and the nuclear salt solutions were dried and photographed. No similarities between these preparations and those of the nucleus were observed.

The investigations are being extended in the belief that they will throw added light on the structure of such chromosomes and will clear up such problems as the time at which the chromomena thread becomes doubled.

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[4] W. H. Roever, *Bull. Amer. Math. Soc.*, 456, 1915.

[1] W. R. Duryee, "Cytology, Genetics and Evolution," University of Pennsylvania Press, Philadelphia, 1941.

CONSIDERATION OF THE ADEQUACY OF BIOMICROSCOPY AS A METHOD OF DETECTING MILD CASES OF VITAMIN A DEFICIENCY

RECENTLY Dr. H. D. Kruse has reported on "The ocular manifestations of avitaminosis A with especial consideration of the detection of early changes by biomicroscopy."[1] He has suggested that "xerosis conjunctivae probably precedes night blindness as an early sign of avitaminosis A," and recommends biomicroscopic examination as a "simple, convenient, objective method" for the detection of avitaminosis A in surveys.

In view of the importance of finding reliable tests for detecting mild degrees of the various avitaminoses, it is relevant to call attention to certain discrepancies between the above-mentioned observations and those reported in a study by Booher, Callison and Hewston in which impaired dark adaptation was produced in five adults by the consumption of a diet adequate in every known dietary essential except vitamin A.[2] The Hecht and Shlaer Adaptometer was used to determine the dark adaptation curves of these subjects. Dysadaption occurred in from 16 to 124 days after the vitamin A-deficient diet was begun and for four subjects was allowed to proceed until the visual threshold after 30 minutes of dark adaptation was elevated by 1 logarithmic unit; subject I of this group was continued on the experimenal diet until the 30-minute threshold was 4 logarithmic units above normal, while at this time of greatest visual impairment, the rod structures were not functioning at all below the scotopic threshold of the cones. Thus, there was no question of the existence of hemeralopia in any of the five subjects.

During the period of greatest impairment in retinal function, a slit-lamp examination was made on subject I by Dr. Alan C. Woods, of the Wilmer Ophthalmological Institute of The Johns Hopkins Hospital. There was no evidence of abnormality. The remaining four subjects were examined with the slit-lamp by Dr. William M. Rowland of the same institution both before and during impaired adaptation, as well as after that function had returned to normal following the administration of moderate amounts of vitamin A. Neither did any of these subjects show conjunctival or corneal changes at any of the examinations.

Attention should also be called to the work of Youmans *et al.*, who conclude that mild degrees of vitamin A deficiency can exist without any modifica-

[1] H. D. Kruse, *The Milbank Memorial Fund Quarterly*, 19: 207, 1941.

[2] L. E. Booher, E. C. Callison and E. M. Hewston, *Journal of Nutrition*, 17: 317, 1939.

tion of the ocular epithelia, as diagnosed by microscopic examination of conjunctival smears.[3] Similar observations have been made in this laboratory.

The cases reported by Dr. Kruse were obtained from a low-income group of which a dietary survey was being made. In such a group multiple dietary deficiencies are the rule rather than the exception. Therefore, it is important that further investigation of conjunctival and corneal changes be made on subjects with uncomplicated experimental vitamin A deficiency before complete reliance is placed in the biomicroscopic examination as a routine method of detecting mild cases of vitamin A avitaminosis.

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SOME FACTORS IN THE NUTRITIONAL DETERMINATION OF HISTORY

In his paper concerning the social implications of vitamins, Williams[1] suggested that the enjoyment of a more generous supply of thiamin and other vitamins by the Germans than by other peoples of Western Europe might explain the present European situation. Thiamin has also been referred to by others as "the morale vitamin." However, I am inclined to agree with Clendening[2] that the importance of vitamins in national nutrition is being grossly exaggerated. False hopes of simple solutions of nutritional problems appear to be raised by an over-emphasis on the value of vitamins. Indeed, it remains to be seen whether the use of "enriched" foods and vitamin preparations will do much more in the long run than increase the incidence of obesity, diabetes and other disorders promoted by over-nutrition.

The developments in Europe during the past 25 years nevertheless seem to present excellent illustrations of the effects of some nutritional factors, independent of the vitamin supply, on the rise and decline of nations or cultures throughout the ages. That is, a nation or culture can develop only when or where a sufficient supply or surplus of food becomes available. In a society with constructive or progressive tendencies, a sufficiency or surplus of food serves, in part at least, to provide leisure for some to develop the arts. Among even the most primitive arts has been that of catering to the appetite. This art has conspicuously manifested itself in tribal feasts, in the Roman banquets and, in recent Europe, by French cuisine. The Roman banquets probably sealed the fate of the Roman Empire and French food and wine were very likely factors in the fall of France. In short, too much food or an excessive catering to the appetite can wreck an empire just as surely as it can ruin an individual.

On the other hand, seasonal variations in the food supply, periodic famines, wars and more or less fasting under religious influences in the past apparently served to avert an otherwise precipitate decline of some nations or cultures because of the common tendency to self-indulgence in the midst of plenty. Thus, in India and China, a relatively steady state or balance between the supply or use of food and cultural attainment has long been maintained. In the first World War, German resistance cracked partly because of simple undernourishment due to the food blockade and, shortly after that, Russia came close to complete collapse because of famine conditions in that country. However, it does not seem to be sufficiently realized that the outburst of the German spirit since the first World War and the recent stubborn resistance of the Russians to invasion are explainable as physiological and psychological consequences of more liberal food supplies following periods of enforced food restriction or starvation. The observations of Carlson,[3] Kunde,[4] Glaze[5] and McCay[6] indicate that a manifestation of physical and/or mental improvement is to be expected with re-alimentation after periods of fasting or food restriction. Moreover, the results of my personal experience, which involves a total of about 600 days of fasting during the past 33 years and also some observations on others, lead me to believe that the most striking after-effects of fasting or food restriction occur between the ages of about 20 and 35. In the German and Russian experiences, this means in those who are now between about 40 and 60 years of age and therefore in active control.

If the foregoing views are correct, it would seem of more importance in America to guard against the insidious effects of dietetic excesses among the "well-fed" millions than to concentrate on raising the nutritional standards of the extremely poor. In any case, so-called deficiency diseases may often be excess diseases—due to excessive intakes of carbohydrates, fats and/or proteins. I believe that a sufficiently keen appetite is about all that is needed to lead one to choose an adequate diet and that the appetite can best be kept keen by occasional periods of voluntary food restriction or fasting. More studies ought to be made on the after-effects of fasting and simple undernutri-

[3] J. B. Youmans, M. B. Corlette, M. G. Corlette and H. Frank, *Jour. Lab. and Clin. Med.*, 23: 663, 1938.
[1] SCIENCE, 94: 502, November 28, 1941.
[2] *Jour. Am. Med. Assn.*, 117: 1035, 1941.

[3] "The Control of Hunger in Health and Disease." Chicago. 1916.
[4] *Jour. Metabolic Research*, 3: 399, 1923.
[5] *Am. Jour. Psychol.*, 40: 236, 1928.
[6] "Chemical Aspects of Aging." In Cowdry, "Problems of Ageing." Baltimore. 1939.

tion. Undoubtedly, many a conscientious objector to military service would be willing to volunteer for such nutritional study.

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FALSE BLOSSOM IN PERIWINKLES AND ITS CURE BY HEAT

One of the chief difficulties in the study of false blossom has been the lack of a host in which the disease could be reproduced as it occurs in the cranberry which, for various reasons, is not a good experimental plant. Under the stimulus of finding a favorable host in which to observe the efficacy of heat treatments for cure of false blossom, attempts were made to transmit virus from cranberries to periwinkles (*Vinca rosea*). The parasite, *Cuscuta campestris* Yuncker, which had been shown to transmit certain other viruses,[1] was used. It proved to be an efficient vector. Through its parasitic activities, false blossom was taken to periwinkles and also to potato, tomato, tobacco and *Nicotiana glutinosa* plants. Under favorable conditions the disease appeared in periwinkles within about one month after exposure to the parasite. The virus was readily transmitted in all the new hosts by grafting.

False blossom periwinkles were cured easily by heat treatments. Exposures at 40° C for one week cured the tops but not the roots, but exposures for two weeks cured both tops and roots. Diseased periwinkles were able to endure the treatments without serious injury. Whether false blossom can be cured in the cranberry has not yet been determined. Experiments designed to test this possibility are in progress. In its reaction to heat in periwinkles, false blossom virus behaves similarly to that of aster yellows.

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SCIENTIFIC BOOKS

SINANTHROPUS PEKINENSIS

The Extremity Bones of Sinanthropus Pekinensis. By Franz Weidenreich. *Paleontologia Sinica* New Series D. No. 5. 82 pp. 20 tables. 34 plates. Peking, 1941.

This latest paper in the long series of studies of the *Sinanthropus* material by Dr. Weidenreich had received only a sparse distribution in the United States before the outbreak of war halted its importation. Because of the tremendous interest attaching to the Choukoutien remains, as well as the inaccessibility of many of the accounts dealing with the material, a summary may be useful.

Unfortunately the Peking calvariae have not been accompanied by a similar abundance of arm or leg bones. So far we possess only seven fragments of femur, two of the humerus, one of the clavicle and one carpal bone: the *os lunatum*. Nevertheless, these remains are such as to permit observations concerning their general evolutionary status.

In the case of the femur, Dr. Weidenreich believes the material justifies the conclusion that *Sinanthropus* was short in stature, approximating the average of the present-day Eskimo or Japanese. The structure of the bone betrays certain distinctive traits. The medullary canal of the shaft is, for example, very narrow and the walls correspondingly thick—much more so than in modern man. Neanderthal femora are more rugged, and the degree of forward bending of the shaft in this latter form is much more pronounced than in the Peking type. In these two respects, *Sinanthropus* approaches *sapiens* more closely than does *neanderthalensis*. All in all, some nine minor characters are noted as more or less distinctive and apparently specific for *Sinanthropus*. Nevertheless, the femur is definitely human in character, and there is no doubt that Peking man walked erect. The proportions, the presence of a linea aspera, and the position of the gluteal tuberosity, are definitive upon this point.

The humerus, also, is of human character. As in the case of the femur, a few minor peculiarities are noticeable. They are, however, features occasionally to be observed in modern man. The humero-femoral index, which expresses the length of the humerus as a percentage of the length of the femur, is indicated at about 79. This falls in the existing human range, whereas in the anthropoids the index ranges well over 100. An index of 79 is thus amply suggestive of the essentially human and upright posture of *Sinanthropus*.

The semi-lunar wrist bone or *os lunatum* is similarly human, though its height-breadth and length-breadth indices are variant in an anthropoidal direction. The clavicle is seemingly more akin to modern man than that of *neanderthalensis*.

There seems no doubt, in view of the above evidence, that Dr. Weidenreich's contention that man had already assumed an erect posture, in other words was a bipedal ground-dwelling primate before his skull and dentition had been so extensively modified in a human direction, is fully acceptable.

[1] Folke Johnson, *Phytopath.*, 31: 649, 1941.

Expressing the opinion that *Pithecanthropus* and *Sinanthropus* can, at best, be regarded as no more than racially distinct, Dr. Weidenreich is sharply critical, justifiably so in the eyes of this reviewer, on the inadequacy of our present nomenclature in relation to the taxonomy of the Hominidae. Obviously it demands revision. He also argues on the basis of the Choukoutien femur fragments that the famed Trinil thigh bone can not possibly represent the same individual as the *Pithecanthropus* calvarium. In addition he reaffirms his belief in the Mongoloid affinities of *Sinanthropus*.

Irrespective of the eventual settlement of some of these perennial and favorite subjects of debate, the value of Dr. Weidenreich's contributions upon the subject of fossil man can not be overemphasized. He has been as prompt as is consistent with scientific accuracy in issuing reports; in wealth of anatomical detail and comparison with other fossil forms, his studies have lifted human paleontology to a new level of attainment. In all these matters the present monograph maintains the same high standard. One hopes that further publications may be undertaken here in the United States and that the exigencies of war will not completely interrupt, at least in terms of laboratory study, the intensive exploitation of the most remarkable body of material yet acquired on the human history of the earlier Pleistocene.

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WATER-SUBSTANCE

Properties of Ordinary Water-Substance. American Chemical Society Monograph. By N. ERNEST DORSEY. xxiv + 673 pp., 13 figs., 289 tables. New York: Reinhold Publishing Company. 1940.

THIS book assembles all the physical constants of ordinary water-substance (excluding isotopes). Never before have they been gathered into one volume. Of course, those who need to use such constants know already that this book is indispensable, and need not be told what a masterpiece it is; but it has a wider usefulness which should be pointed out. Water is of interest not only to physicists, chemists and engineers. It is one of the fundamental substances of the universe, just as the ancients suspected. Any one who doubts this fact is referred to Dr. Dorsey's classic as proof.

This book of tables, so exhaustive, so meticulously assembled, compared, recomputed and revised (which a veteran of the National Bureau of Standards could be depended upon to produce), can be studied as a yardstick of physical science. Lincoln once explained to a jury what the word "demonstrate" meant. He said he looked the word up in the dictionary and found "to demonstrate, as a proposition in Euclid." So he got a copy of Euclid and by the time he had finished it he understood what "demonstrate" meant.

Now too many who have never had much discipline in physics are being swept off their feet by much modern jargon, which impresses them about as the squabbles of the medieval schoolmen. Too many fifth-columnists against science are exploiting this confusion to undermine public faith in the facts of physics, very often with funds exploited from scientific discovery. A perusal of this book, checking up a few of the sources, can be depended upon to produce a healthy respect for the reality of science. Thus, it provides a vista of the anatomy of science which should be viewed by every college student.

After carefully defining symbols and units, the energy constants for the synthesis and dissociation of water are presented. Then single-phase systems, water vapor, liquid water and ice, and finally multiple-phase systems and phase transition are covered in over 600 pages of tables. Each table is explained briefly, and after each are given the references to the sources of the data; but to present them in comparable form an immense amount of recomputation has been necessary, often revealing and correcting errors in previous compilations.

The purpose of these tables has been to provide the inexpert with the data he may need, explaining the formulas and methods on which they are based, and giving the means of more detailed study when desired. Any one interested, therefore, can find out immediately the status of the facts up to 1938, and search the literature himself for more recent data. The book is a monument to its author, its institution, and to the myriad devoted workers whose careful labors are assembled.

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REPORTS

THE ANNUAL REPORT OF THE DIRECTOR OF THE NEW YORK BOTANICAL GARDEN

THE report of Dr. William J. Robbins, of the New York Botanical Garden, reviewing the four years of accomplishment of the garden since 1937, when he became director, was presented at the annual meeting of the board in January. He stated that, even though war might modify and curtail activities, the institution

would, he hoped, "continue to make most effective use of those facilities and funds at our disposal, regarding them as a public trust to be used for the benefit of the public."

Fifteen men, or fourteen per cent. of those employed by the garden, are already serving with the Army and Navy, and more are expected to go. Besides this direct participation in the war, the garden is aiding in many ways in the present emergency. Dr. Robbins then described the new "victory course," in vegetable gardening, one of which is given in cooperation with *The New York Times.* Both afternoon and evening classes are to be given, a three-day short course was offered and a demonstration course in vegetable garden management. The garden will maintain a model vegetable garden out-of-doors during the spring, summer and early fall.

For the relief of present conditions in this country, the garden furnishes information on plants for industries which are suffering the loss of materials through the war.

While the garden has kept strictly within its budget during the past four years, Dr. Robbins pointed out that since its establishment and the construction, around 1900, of the main buildings, no period has witnessed such a marked improvement in material facilities as in the years since 1937. Also, notable horticultural accomplishments can be recorded, and there is evidence on every hand of greater public interest and increased service to the public. He mentioned particularly the following accomplishments:

The number of hardy trees and shrubs in the permanent collections has been doubled.

The number of kinds of plants now cultivated regularly at the Garden is more than 12,000.

The educational program lately initiated and developed attracted more than 400 students last year.

Attendance at the free lectures given on Saturday afternoons has more than doubled (increasing from 3,060 in 1937 to 7,000 in 1941).

Subscriptions to the Garden's monthly journal have grown from 75 to nearly 700 in the past three years.

Most of the conservatory displays have been replanted in naturalistic fashion. Also, the main conservatories were almost entirely rebuilt. (They were first constructed 40 years before.)

The Garden's 280 acres were completely surrounded by a fence for the first time.

Much reconstruction was done in the Museum Building, including installation of a reception room for members.

Considerable new construction was added to improve the facilities for growing plants.

Arrangements for a new base plan for the future development of the garden have been completed. Major Gilmore Clarke is now working on the plan, which has been made possible through the generosity of Mrs. Harold I. Pratt, a member of the Board of Managers. The fencing of the grounds in 1940 has made necessary a number of changes in landscaping and in traffic routing.

Accomplishments of the year 1941 include:

Beginning of construction of a walled experimental garden for the use of members of the scientific staff.

Receipt of many thousands of plants as gifts, a number of them extremely rare, and among them the Forster collection of nearly 10,000 orchids valued at $75,000; 2,000 cactus plants from the Government of Mexico; and a total of 4,000 bulbs, orchids and other plants from two individual donors.

Nearly 50,000 individual plants set out (chiefly in front of the Main Conservatories and the Museum Building) for bedding effects in the spring and summer. These included 10,000 tulips saved from the display of the previous year, which had been a gift of the Holland Bulb Industries.

More than 4,000 shrubs planted on the grounds, including large numbers of rhododendrons, flowering cherries, barberries, lilacs, evergreens and other ornamentals. New labels required for these and other plants in cultivation at the Botanical Garden during the year totaled more than 5,400. Of these 49 were of the informational type, placed mostly beside plants of economic usefulness.

Addition of 36,747 herbarium specimens to the scientific collections, bringing the total of this important reference collection of preserved plants to 2,056,296 specimens, comprising the largest herbarium under one management in the United States.

Addition of books to bring the total bound volumes in the library close to the 50,000 mark.

Officers of the garden, all reelected for the current year, are: Joseph R. Swan, *President;* Henry De Forest Baldwin and John L. Merrill, *Vice-presidents;* Arthur M. Anderson, *Treasurer;* and Henry de la Montagne, *Secretary.*

SPECIAL ARTICLES

NARCOTIC POTENCY OF BIURETS CONTAINING PIPERIDINE

HILL and Degnan[1] noted that l-diethylacetyle-5,5-cyclopentamethylene biuret has hypnotic properties and comparatively low toxicity. Following a different chemical procedure than previously employed, 9 additional biurets have been synthesized.[2] These are

[1] A. J. Hill and W. M. Degnan, *Jour. Amer. Chem. Soc.*, 62: 1595, 1940.

[2] C. H. Ch'eng and Peter P. T. Sah, in preparation.

diphenyl-5-phenyl biuret (m. p. 134° C.), 1-phenyl-5-pentamethylene biuret (m. p. 153° C.), 1,1-pentamethylene-5,5-pentamethylene biuret (m. p. 198° C.), and 5,5-pentamethylene biuret (m. p. 121° C.).[3] All derivatives are crystals and the first 3 are poorly soluble in water or alcohol. One per cent. water solution of 1,1-pentamethylene-5,5-pentamethylene biuret may be made by heating and keeping the solution at 37° C.

The monopiperidine biuret is less toxic for mice than sodium barbital, sodium pentobarbital or sodium dilantin but more toxic than paraldehyde. The LD_{50} for mice is 600 mg/kg on intraperitoneal injection. This amount antagonizes a surely fatal dose of picrotoxin and usually of strychnine but does not protect mice against cocaine.[4] Hypnotic doses of the biuret in rabbits of 60 mg/kg given intravenously slightly depress blood pressure and cardiac rate during the injection only, but do not affect respiration or uterine activity.[5] Inhibition of uterine strips, from humans and rabbits occurs in dilutions of 1:2,500 to 1:5,000 *in vitro*. It is 30 and 10 times less potent than sodium dilantin and sodium pentobarbital, respectively. The total oxygen uptake of rat liver during a 60-minute period is depressed approximately 35 per cent. by the monopiperidine biuret, 0.1 gm/100 cc; 75 per cent. by sodium pentobarbital, and inappreciably by paraldehyde and sodium barbital.[6]

Dipiperidine biuret is even less toxic for mice, the LD_{50} being 1,250 mg/kg on intraperitoneal injection. It is less active as an antagonist of chemicals affecting different levels of the central nervous system. It antagonizes cocaine convulsions but does not save mice given lethal amounts; no protection against strychnine convulsions is provided, and all picrotoxin-treated mice had convulsions after an LD_{50} dose of this biuret but none died. In rabbits, narcosis follows intravenous injections of from 100 to 200 mg/kg without appreciable effect on respiration, on blood pressure except during the injection, or on the blood sugar during or following narcosis. Uterine activity *in situ* is inhibited with these doses. *In vitro* tests indicate that smaller concentrations of the dipiperidine than of the monopiperidine biuret are inhibitory. Dilutions of 1:7,500 to 1:10,000 for human uterine strips and from 1:15,000 to 1:20,000 for rabbit strips are effective. In this respect the dipiperidine biuret resembles sodium pentobarbital. Depression of oxygen consumption of rat liver follows exposure to 0.1 gm/100 cc of this agent for 60 minutes.

Since the dipiperidine derivative has pharmacologic activities similar to sodium pentobarbital, except that it is 1/10 as toxic, the narcotic potency at various dose levels was studied in inbred white mice and inbred white rats. The graph indicates the duration of nar-

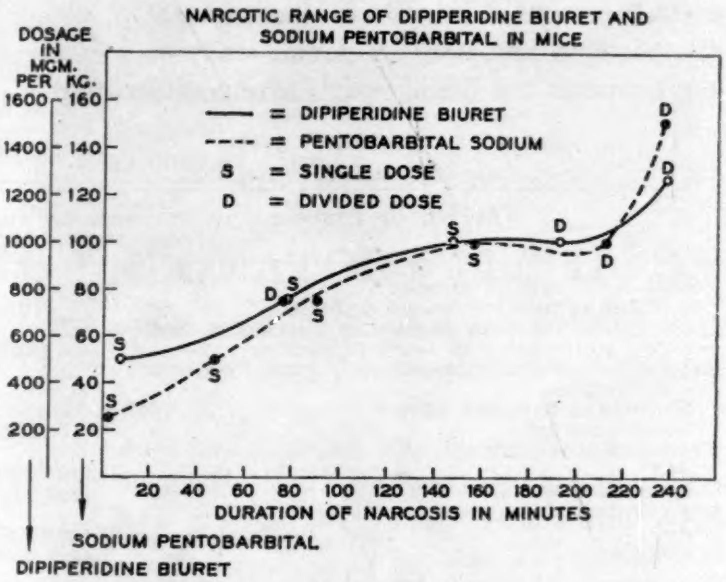

FIG. 1.

cosis in mice after intraperitoneal injection in single or divided amounts. Preliminary studies after oral administration to rats provided similar data. At the onset of narcosis there is no excitement and during the depth of narcosis respiration is more regular and less depressed than noted in pentobarbital treated animals.

Preliminary observations on the effect of the dipiperidine biuret in 60 and 120 mg/kg doses intravenously in the rabbit at term indicate that fetal respiratory movements are not significantly affected by these amounts.[7]

Summary: Five biurets, 4 containing piperidine, have been prepared and various pharmacologic activities of 2 have been studied. The monopiperidine derivative effectively antidotes picrotoxin and strychnine, while the dipiperidine biuret is life-saving to mice given lethal doses of picrotoxin. Uterine activity and the oxygen consumption of rat liver are depressed more by the dipiperidine biuret. Neither derivative appears to be as toxic as commonly used hypnotics or anticonvulsants with which a comparison was made, except paraldehyde. Narcosis of mice,

[3] We are grateful to Dr. Stanley Wilson, Yenching University, for checking nitrogen determinations of these compounds.

[4] C. H. Ch'eng, H. H. Anderson and S. Y. P'an *Jour. Pharmacol. and Exper. Therap.*, 72: 7, 1941; H. H. Anderson and S. Y. P'an, *Proc. Soc. Exp. Biol. and Med.*, 46: 11, 1941.

[5] S. Y. P'an and C. S. Lu, *Chin. Jour. Physiol.*, 16: 311, 1941.

[6] S. Y. P'an and C. S. Lu, in press.

[7] K. T. Lim, personal communication.

rats and rabbits produced by the dipiperidine biuret resembles that of pentobarbital but is less disturbed.

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FLUORINE ACQUIRED BY MATURE DOG'S TEETH[1]

THE post-eruptive deposition of fluorine in the enamel[2,3,4] and dentine[3,4] of molar teeth of young rats has been reported. A similar study on a mature dog supports this finding particularly with regard to the dentine. At the beginning of this study a two-year-old mongrel dog with full dentition had three representative teeth extracted. Sodium fluoride was then given via food and drinking water for definite periods, each period terminating with the extraction of two or three comparable teeth. Food and drinking water were consumed ad libitum. The pooled teeth representing each period of exposure to fluoride were separated into dentine and enamel and analyzed for ash and fluorine.

The results for each successive sample of dentine show that the mature dentine increased in fluorine decisively. The enamel does not show a similarly consistent nor equal percentage-increase. The final sample of enamel, however, contained 0.011 per cent. fluorine as compared with 0.006 per cent. fluorine in the initial or control enamel. In this connection it is interesting to note that the enamel of carious human teeth and the enamel of non-carious human teeth have been reported to contain 0.0069 per cent. and 0.0111 per cent. fluorine, respectively.[5] A distinction possibly may be made in tooth fluoride acquired post-eruptively and fluoride which is acquired during the formative period of the tooth.[3,4] Fluoride given during gestation and lactation to mother rats, *i.e.*, during the period of tooth formation in their young, appears to diminish susceptibility to caries in the offspring.[6] There is certain limited epidemiological evidence with respect to human dental caries,[7] which seems to agree with this latter finding in rats.[6]

These results for the dog's teeth and similar results based on young rats[2,3,4] advance speculation regarding post-eruptive chemical modification, as a property of calcified dentine and enamel. Fluoride retention may prove a useful tool in studying individual variations in dentine and enamel in relation to tooth age and susceptibility to dental caries. In the results for the enamel fluoride the property of the enamel to adsorb fluoride on the oral surface[2] may receive further support, although a systemic retention via the dentine can not be discounted.[3,4]

TABLE I

EFFECT OF EXPOSURE TO FLUORIDE ON THE FLUORINE CONTENT OF THE DENTINE AND ENAMEL OF A MATURE DOG'S TEETH

Pooled teeth sample number		I	II	III	IV	V
Age of dog at time teeth were extracted.	(days)	730	796	900	1,145	1,289
Total number of days exposed to fluoride in food and water prior to tooth extraction	(days)	0	66	170	415	559
Exposure to fluoride immediately prior to tooth extraction.						
Fluoride in food and water	(ppm)	0	15	45	100	500
Total time fed	(days)	0	66	104	245	144
Composition of dentine						
Ash	(per cent.)	71.90	71.88	73.15	73.35	73.21
Fluorine	(per cent.)	.018	.022	.039	.059	.072
Composition of enamel						
Ash	(per cent.)	95.20	95.75	95.72	96.32	95.96
Fluorine	(per cent.)	.006	.007	.009	.007	.011

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[1] The author is indebted to Passed Assistant Dental Surgeon Francis A. Arnold, Jr., for assistance in the experimental work.

[2] M. W. Perry and W. D. Armstrong, *Jour. Nutrition*, 21: 35, 1941.

[3] F. J. McClure, *Jour. Nutrition*, 22: 391, 1941.

[4] F. A. Arnold, Jr., and F. J. McClure, *Jour. Dent. Rsh.*, 20: page 457, 1941.

[5] W. D. Armstrong and P. J. Brekhus, *Jour. Dent. Rsh.*, 17: 393, 1938.

[6] G. J. Cox, M. C. Matuschak, S. F. Dixon, M. L. Dodds and W. E. Walker, *Jour. Dent. Rsh.*, 18: 481, 1939

[7] H. T. Dean, P. Jay, F. A. Arnold, Jr., and E. Elvove, *Pub. Health Rep.*, 56: 365, 1941.

FURTHER NOTES ON THE INCUBATION PERIOD OF THE PEACH MOSAIC VIRUS[1]

ADDITIONAL information regarding the seasonal spread of peach mosaic from diseased to healthy trees and the incubation period of the causal virus has been obtained during the 1941 growing season.

Seeds from "natural" peach seedlings are used in

[1] Published with the approval of the director as paper number 130, Scientific Journal Series, Colorado Agricultural Experiment Station.

our experimental plots because the virus of peach mosaic is not transmitted through the seed of the peach.[2] Seeds were planted in November, 1940, at Whitewater, Mesa County, Colorado. On May 15, 1941, the seedlings were approximately from 4 to 6 inches in height. On this date Elberta peach nursery trees in this area were well leaved. Twenty feet to the west of the seedling plot, which totaled approximately 400 trees, was a row of 30 three-year-old Elberta trees affected with the severe strain of the peach mosaic virus. Fifteen of the seedling trees on August 25, 1941, showed symptoms of the severe strain of the peach mosaic virus. These symptoms were evident in the new growth. Under these conditions of natural spread the incubation period was approximately 100 days or less and the spread of the disease occurred in the spring. This natural spread of the disease has never been observed in one-year-old Elberta peach trees in commercial orchards. It has been recorded in only a very few instances in the past in two- and three-year-old Elberta trees.[3]

Approximately the same length of time for the incubation of the virus has been demonstrated when bud and graft inoculations have been made in the spring.[2] In these latter cases symptoms of mosaic were shown by inoculated trees during the same growing season. On the other hand, trees inoculated in mid-summer or later did not show symptoms of mosaic until the following spring.

These studies re-emphasize the need for the immediate removal of all diseased trees as soon as leaf symptoms are evident.

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[2] Lee M. Hutchins, E. W. Bodine and H. H. Thornberry. U. S. Department of Agriculture Circular No. 427. 1937.

[3] E. W. Bodine and L. W. Durrell, *Phytopath.*, 31: 322–333, 1941.

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE MECHANICAL SHAKER

A number of mechanical shaking devices are reported in the literature.[1–10] Some of these are of excellent design but involve considerable expense as well as the services of a trained mechanic in their construction. This places them beyond the means of many small projects.

Schwarz and Shapiro[9] have pointed out the advantages of the reciprocating type of shaker as compared to the rotating type, since the rapid changes in momentum of the liquid produce greater agitation. The reciprocating type, however, is subjected to considerably more strain in operation, and unless very good alignment is obtained the machine soon breaks down.

An almost ideal combination of advantages in construction, design and type of action is furnished by an ordinary sewing machine head. From it a mechanical shaker can easily be built which is compact, convenient and quite inexpensive. Following is a description of the shaker designed for use in this laboratory:

The sewing needle is detached and a thin strip of iron eight inches long by five-eighths inch wide is welded into its place. To this strip is fastened a wooden rack twelve inches long by seven inches wide. This rack is designed to hold flasks during shaking and is equipped with appropriate fittings. The wheel of the sewing machine is replaced by a pulley of desired size and the shaker is then powered by a belt drive from a 1/16 h.p. motor. The accompanying diagram (Fig. 1) illustrates its construction.

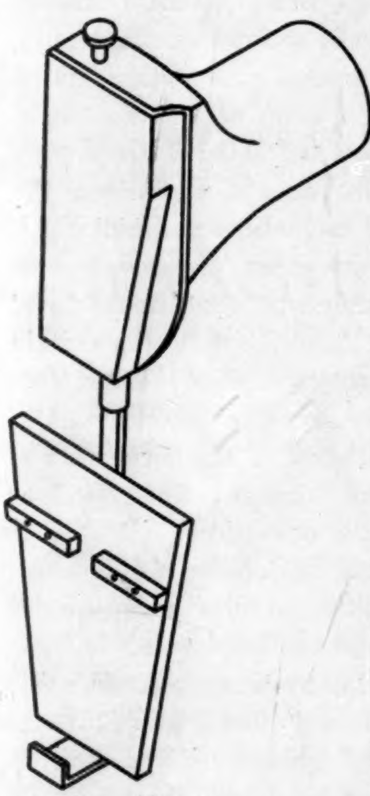

Fig. 1.

In order to reduce excessive noise and vibration at high speeds (200 strokes per minute), the shaker is made to operate against a slightly stretched screen door spring which is fastened to a stationary object (in this case the floor). A rubber eraser fastened to the shaker stand is placed so as to make a sliding contact with the flat surface of the moving flask carriage. The eraser thus acts as a guide for the carriage and effectively eliminates horizontal vibration. Care should be taken not to

[1] Anon., *Chem. Ztg.*, 36: 679, 1912.
[2] L. B. Berchardt, F. C. Hildebrand and B. A. McClellan, *Cereal Chem.*, 15: 116, 1938.
[3] J. M. Feder, *Jour. Lab. Clin. Med.*, 23: 974, 1938.
[4] R. B. Fisher and A. E. Wilhelmi, *Biochem. Jour.*, 32: 609, 1938.
[5] Fritz Haufland, *Chem. Ztg.*, 32: 1213, 1908.
[6] Joseph H. Holt, *Jour. Lab. Clin. Med.*, 23: 533, 1938.
[7] Arthur G. Milligan, *Jour. Chem. Soc.*, 125: 674, 1924.
[8] Theodore Neustadter and Raymond Holz, *Jour. Lab. Clin. Med.*, 23: 313, 1937.
[9] E. R. Schwarz and Leonard Shapiro, *Ind. Eng. Chem., Anal. Ed.*, 10: 281, 1938.
[10] W. Steinkopf and H. Winternitz, *Chem. Ztg.*, 37: 40, 1913.

place too great a load on the shaker when it operates at high speeds, an audible "knock" warning the operator in such cases.

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AUTOLOGOUS PLASMA CLOT SUTURE OF NERVES

FIBRIN suture of peripheral nerves accomplished by the use of fortified cockerel plasma with chick embryo extract as the clotting agent has been described by Young and Medawar.[1] These authors reported encouraging results following application of the method to suture of the sciatic nerve in rabbits. In repeating these experiments, we have found considerable inflammatory reaction with fibrosis at the site of the nerve suture. Because such reaction may seriously interfere with proper regeneration of nerve fibers, we have been led to study the suitability of autologous plasma clotted with autologous muscle extract for suture of peripheral nerves. Among other advantages, the procedure has proved to be simpler than the method employing heterologous materials.

The technique consisted of exposing and cutting the sciatic nerves of rabbits, bringing the retracted stumps together with jeweler's forceps, depressing the ends so as to form a trough and adding first 5 drops of plasma and then 1 drop of tissue extract. The fluids were mixed *in situ* and about 3 drops were withdrawn into a pipette to reduce to a minimum the amount of clot remaining as suture material. Although clotting occurred in about 40 seconds, the nerve ends were held together with the forceps for 4 minutes after addition of the fluids to make certain that the clotting process was complete. When tension on the suture line was great or the clot was of poor tensile strength, separation of the nerve stumps followed withdrawal of the forceps. This occurred in about 30 per cent. of the operations.

In order to evaluate the suitability of different suture materials, comparative studies were carried out with cockerel, human and rabbit plasma. In most of the experiments, heparinized or unmodified mammalian plasma was used and fortification of the plasma by the addition of fibrinogen was omitted. When no anticoagulant was employed, the blood was drawn into a chilled syringe coated with mineral oil and immediately transferred to paraffin-lined test-tubes packed in ice. The tubes were centrifuged in 250 cc cups filled with ice. In a few instances, citrated plasma was used and clotting was induced by addition of calcium chloride and tissue extract.

[1] J. Z. Young and P. B. Medawar, *The Lancet*, 2: 126, 1940.

Concentrated saline extracts of mouse lung and rabbit gluteus muscle were employed as clotting agents. One cc samples of plasma were coagulated in test-tubes of 8 mm internal diameter and the clots tested for tensile strength. Although great variation was found, the results indicated a superiority of mammalian over cockerel plasma. The average tensile strength found in 74 tests of human plasma was 89 grams; in 34 tests of rabbit plasma, 34 grams; in 16 tests of cockerel plasma from 4 birds, 19 grams.

Suture of the sciatic nerves was done in 27 rabbits. Rabbit plasma was employed in 19 of the sutures, while human and cockerel plasma were utilized 13 and 9 times respectively. Silk sutures and other control procedures were carried out in 11 instances. The sutured nerves were removed 2 to 26 weeks after suturing. Microscopic studies showed evidence indicating that the nerve fibers readily grow beyond the suture line into the distal end of the nerve.

These experiments have progressed sufficiently to permit the following conclusions:

(1) Rabbit plasma with rabbit muscle extract is superior to cockerel plasma with chick embryo extract for nerve suture in rabbits. The former clots possess greater tensile strength and provoke less inflammatory and fibrotic reaction.

(2) Clots obtained from human plasma cause more tissue reaction in rabbits than clots obtained from rabbit plasma.

(3) Autologous plasma clot suture of nerves in rabbits compares favorably with silk suture in the amount of resultant tissue reaction. The former moreover obviates the disadvantages of strangulation and disorganization of nerve fibers which occurs with silk suture, especially in small nerves with delicate connective tissue sheaths. When the nerve stumps are under tension, plasma clot suture is, at present, not as desirable as silk suture, since it possesses less holding power.

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BOOKS RECEIVED

DAY, CHAPIN W. and MARGARET RITCHIE. *Studies and Activities in Biology.* Edited by John W. Ritchie. Pp. vi + 218. World Book Company. $0.80.

MORRIS, EARL H. and ROBERT F. BURGH. *Anasazi Basketry, Basket Maker II through Pueblo III.* 4? figures. Pp. viii + 65. Carnegie Institution of Washington. $1.50.

Philosophies of Education. Forty-first Yearbook of the National Society for the Study of Education, Part I. Edited by NELSON B. HENRY. Pp. vii + 321. Public School Publishing Company.

Studies in Mathematical Economics and Econometrics in Memory of Henry Schultz. Edited by OSCAR LANGE, FRANCIS MCINTYRE and THEODORE O. YNTEMA. Pp. 292. The University of Chicago Press. $2.50.

SCIENCE NEWS

Science Service, Washington, D. C.

SOLAR MAGNETISM

CLOSE relations between events on the sun and conditions on earth, due in part to the magnetic nature of both great globes, were traced in the Arthur Lecture, delivered on February 26 at the Smithsonian Institution by Dr. John A. Fleming, director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington.

The sun, Dr. Fleming pointed out, is a vast sperical magnet, on the same essential pattern as the earth, except of course that it is much larger. Force of its surface magnetic field is also much greater—about 100 times as intense as the earth's.

The magnetic poles of the sun resemble those of the earth in not being located exactly on the rotational poles. The eccentricity is not so great on the sun, however; its north magnetic pole is only four degrees removed from its north rotational pole, whereas the earth's magnetic north pole and rotational north pole are 11.5 degrees apart.

The sun's magnetism does not directly affect the magnetic field of the earth. Despite its hundred-fold greater magnitude, it is still too feeble to produce noticeable changes so far away. The great magnetic storms that sweep about the earth from time to time, almost always accompanied by auroral displays, are directly traceable to streams of electrical particles poured through space; these grow greater and less in step with changes in solar magnetism.

Magnetic storms, it should be pointed out, are not related to electrical storms or other visible and audible disturbances in the earth's atmosphere. These are relatively local affairs, whereas the great magnetic storms are worldwide, and are utterly silent and imperceptible to human senses. They make themselves evident mainly through their disruptive effects on wired and wireless communications when they are at their height.

Auroras, the only visible effects or concomitants of magnetic storms, are relatively remote affairs. Whereas the highest clouds of "weather" storms are only a few miles up, the lowest of the polar lights that have ever been measured have had altitudes of about 50 miles, and they range from that up to 300 miles.

"GALLOPING GERTIE" BRIDGE

"GALLOPING Gertie," bridge over the Tacoma Narrows in Washington State, bounced up and down to the extent of making some people sea-sick and finally collapsed. The bridge bounced up and down even though the wind was steady and horizontal.

This curious behavior has at last been brought to leash under the most severe mathematical formulae and probably won't happen again. The restraining formulae have been supplied by Professsor Norman Levinson, of the Massachusetts Institute of Technology, and were reported on February 28 to the American Mathematical Society meeting at Columbia University.

This perversely vertical vibration, at right angles to a steadily blowing wind, is but one instance of many other examples of the same sort which until now have defied mathematical analysis. Other instances, Dr. Levinson mentioned, are the flapping of a flag in a breeze, the vibration of a violin string when bowed, the singing of wires in the wind, the sound issuing from a bottle when one blows across the mouth. They are called "relaxation oscillations."

They occur also in electrical systems containing radio tubes, and this case was investigated mathematically some twenty years ago by the Dutch engineer Van der Pol, and again in 1927 by a French engineer, Lienard. But this is a very restricted field.

Much more general equations have now been developed by Dr. Levinson, applicable to a great variety of mechanical and other situations. In particular, he has found the conditions under which these relaxation oscillations will be kept within narrow safe limits. Also he has found the conditions under which from among several possible modes of oscillation only one will occur in response to the disturbing cause. Such a system will never be at rest but the engineer can so design the structure that the oscillations can never become very great.

SUBSTITUTE DRUGS

THE first substitution of a domestic medicinal drug for one imported before the war has been authorized by the National Formulary and the U. S. Pharmacopoeia. The National Formulary authorizes the substitution of extract of stramonium for extract of belladonna in compound pills of cascara.

Other alterations in drug preparations authorized by the Formulary have so far been of a non-medicinal character. For example, permission is given to omit rose water, once imported from France, from cold cream. Use of distilled water in cold cream instead of rose water, and substitution of persic oil, made from peach and almond kernels, in place of almond oil, are also now permissible.

As a result of the shortage of oil of lavender, the U. S. Pharmacopeia has authorized its omission in aromatic spirit of ammonia and the substitution of oil of cedar leaf for oil of lavender in tincture of green soap. Because of the scarcity of Mediterranean squill, an expectorant used in cough medicine, the Pharmacopeia has recognized a variety of this drug which can be imported from India, *Unginea indica* Kunth. Ergot, used to prevent hemorrhage in the mother after child birth, may now be imported under less rigid packaging requirements, provided it is dried, assayed and repackaged immediately after entry. Ergot comes from Russia and Spain. Amaranth, a red coloring derived from coal tar, may now be substituted for tincture of cudbear, standard red coloring, once imported from Holland. Benzaldehyde is authorized by the Formulary as a substitute for oil of bitter almond, as flavoring agent in official preparations

THE EIGHT-HOUR DAY

LONGER working days may result in decreased output, despite eagerness on the part of both management and workers to rush war production, is indicated by a review of previous experience especially by the British.

With a tremendous incentive such as the war gives to American workers, men can greatly step up their production and working hours for a short period without any breakdown resulting. But if this pace is kept up for any length of time production drops off, sickness and accidents increase and a "staleness" or lack of morale results. Just how long a man's or a woman's working day should be for maximum production depends on the type of work, on the make-up of the individual and also upon social conditions inside and outside the plant.

British industrial authorities have found fifty-six working hours a week to be best for their men. This would amount to five 10-hour days with a 6-hour day on Saturday and with Sunday off. After a trial of longer hours at the beginning of the war, hours in England have been cut to 48 a week for women and from 54 to 60 for most men. Even in Germany an initial trial of longer hours gave way to a restoration of the eight-hour day. The one rest day in seven recommended in the Bible is still found to be essential for retaining working efficiency in the new World War. Enforced rest periods with an opportunity to take food assist in keeping up the output.

In the United States where workers may have been geared to higher production rates and more intensive production methods, the optimum hours should very likely be lower than has been found best for British workers.

Dr. A. C. Ivy, of Northwestern University Medical School, points out in a report appearing in the *Journal* of the American Medical Association, that physical demands placed on the body by labor govern the length of time a worker can stand up under the strain without rest.

Heavy muscular work uses energy at from three to eight times the basal rate. Such work includes many of the heavy manual jobs in agriculture, building trades, mining, heavy industry and forced marches with a heavy load. This sort of work, Dr. Ivy says, can be maintained for eight hours. But the man putting in eight hours or more of this sort of work must have much more to eat and extra vitamins, and possibly extra water and salt. Supervised rest periods are important.

Most factory and office work comes in the class of moderate muscular work which leaves the worker at the end of the day anxious to spend more energy in gardening, ball games or dancing. This does not mean that there is no fatigue. Much factory work, Dr. Ivy points out, involves the use of special or small groups of muscles. Fatigue from this sort of work is hard to measure but nevertheless cuts down output.

Timing is usually the first thing to go wrong when workers at highly skilled tasks are fatigued, it has been pointed out by Professor F. C. Bartlett, the British psychologist. It is also difficult, he found, for workers fatigued at complex tasks to keep their attention on details not closely organized with the main part of their work. At scientific work, the British found that very little more was accomplished in a 66-hour, seven-day week than had been done in the peace time week of 44 hours.—MARJORIE VAN DE WATER.

ITEMS

PAINT that glows in the dark would be used on all walls of factories that may have to be blacked out if the suggestions of Dr. Gorton Fonda of the General Electric Research Laboratory are put into effect. Phosphorescent materials would be painted on the walls. These store up energy when the lights are shining and give it off for a short while when illumination stops. When the blackout comes the walls would continue to give off a faint ghostly glow for a short time during which the workers' eyes would become adapted to the darkness. This would also give time for the workers to find their way to their emergency posts.

EYE injuries to American workmen occur roughly twice every minute and add up to a cost of $100,000,000 every year to American industry while the total number of workmen with impaired vision amounts to 75,000 a year. These estimates were given by Dr. John R. Wittekind of Morrisville, Pa., to the opening sessions of the thirteenth annual convention of the Greater New York Safety Council. Dr. Wittekind said even a minor eye injury costs $14.60 through lost time and production, and added that one out of every four eye injuries results in permanent partial loss of vision. He said nearly 98% of all eye injuries are preventable, and that many injuries now are actually being prevented by the increasing use of safety glasses and goggles.

ORDINARY spool cotton available in any dry goods store can replace silk in sewing up all types of wounds requiring interrupted stitches, according to a report in the current issue of the *Journal* of the American Medical Association. Dr. William H. Meade, East Lansing, Mich., and Dr. Carroll H. Long, Tulane University of Louisiana School of Medicine, report that cotton was used routinely for eighteen months in approximately 1,800 cases at Charity Hospital, New Orleans. They assert that cotton was tolerated better by body tissues than silk and can be used more safely in the presence of infection. "It was clearly demonstrated," their report continues, "that whereas dry, unsterilized cotton has less tensile strength, size for size, than catgut, silk or linen, its tensile strength is less altered by sterilization than is that of other suture materials."

EXPECTING a shortage of steel, many states are considering issuing future automobile license plates for two or more years, according to information received from the American Automobile Association. Michigan is considering two years, Connecticut, five years, and even a permanent license plate has been proposed. Each year, according to one plan, a small strip of steel showing the new year number would be bolted over the old number. Another plan is to substitute paper stickers for the plates. Use of a plastic in place of steel has not been considered because there is also a shortage of plastics. Painting over the old plates must also be discarded because such painting would cost about eight cents against two to three cents for new plates.